DIAGNOSTIC INFORMATION & PROCEDURES

SYMPTOMS - ENGINE CONTROLS

Important Preliminary Inspections Before Beginning

Before using this section, perform the **Diagnostic System Check - Engine Controls** and verify all of the following conditions:

- The engine control module (ECM) and the malfunction indicator lamp (MIL) are operating correctly. Refer to **Malfunction Indicator Lamp (MIL) Inoperative** .
- Diagnostic trouble codes (DTCs) are not stored.
- The scan tool data is within the normal operating range. Refer to **Scan Tool Data List** .
- Verify the customer concern and locate the correct symptom table. Inspect the items indicated in that symptom table.
- Several of the symptom procedures ask for a careful visual/physical inspection. This step is extremely important, and can lead to correcting a condition without further inspections and can save valuable time.
- If the intermittent condition exists as a start and then stall, inspect for any DTCs related to the theft deterrent system. Refer to **Diagnostic System Check - Theft Deterrent** in Theft Deterrent.
- Verify the proper installation of any of the following aftermarket accessories:
  - Lights
  - Cellular phone
  - Remote starter system
  - Aftermarket installed alarm

1. Use the following tables when diagnosing a symptom concern:
   - **Poor Fuel Fill Quality**
   - **Hard Start**
   - **Surges/Chuggles**
   - **Lack of Power, Sluggishness, or Sponginess**
   - **Detonation/Spark Knock**
   - **Hesitation, Sag, Stumble**
   - **Cuts Out, Misses**
   - **Poor Fuel Economy**
   - **Rough, Unstable, or Incorrect Idle and Stalling**
   - **Dieseling, Run-On**
   - **Backfire**

2. If the condition cannot be isolated using the appropriate table, refer to **Intermittent Conditions** for further diagnosis.

INTERMITTENT CONDITIONS

Intermittent Conditions

Inspections	Action
DEFINITION: The condition is not currently present but is indicated in DTC history. OR There is a customer concern, but the symptom cannot currently be duplicated, if the condition is not DTC related.	
Preliminary	• Refer to Important Preliminary Inspection Before Beginning in **Symptoms - Engine Controls** . • The fault must be present to locate a problem using the DTC table. If a fault is intermittent, the use of DTC tables may result in the replacement of good parts.

Visual/Physical	This step is an important aid for locating a condition without extensive testing. Perform a thorough visual and physical inspection of the following:
	• Wiring harness for damage or cuts
	• A misrouted harness that is too close to high voltage or high current devices such as the following:
	  ○ Secondary ignition components
	  ○ Motors
	  ○ Generators
	• Vacuum hoses for the following conditions:
	  ○ Proper routing
	  ○ Proper connections
	  ○ Splits in the hose or the connections
	  ○ Kinks
	• Air leaks at the throttle body mounting area
	• Engine control module (ECM) and body grounds are clean and tight
	• Battery connections are clean and tight
	• Charging system for proper operation-Refer to **Charging System Test** in Engine Electrical.

Harness/Connector Test	Many intermittent open or shorted circuits may be affected with harness and connector movement caused by vibration, engine torque, bumps and rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move the related connectors and wiring while monitoring the appropriate scan tool data.

	• Move the related connectors and wiring with the component commanded ON and OFF, with the scan tool. Observe the operation of the component. • With the engine running, move the related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, the component, system operation, or the engine operation inspect and repair the harness or connections as necessary. Refer to Electrical Connections or Wiring in this table.
Electrical Connections or Wiring	Poor electrical connections and terminal tension or wiring faults cause most intermittents. Perform a careful inspection of the suspected circuit for the following: • Incorrect mating of the connector halves, or terminals not fully seated in the connector body • Improperly formed or damaged terminals • Incorrect terminal tension • Poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body • Corrosion or 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 • Wires that are broken inside the insulation • Pinched, cut, or rubbed through wiring • The wiring coming in contact with hot exhaust components Refer to **Testing for Intermittent Conditions and Poor Connections** , and**Connector Repairs** in Wiring Systems.
ECM Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all engine control module (ECM) power circuits. Many vehicles have multiple circuits supplying power to the ECM. Inspect connections at the ECM connectors, fuses, and any intermediate connections between the power source and the ECM or component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of a circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Power Distribution Schematics** in Wiring Systems. • Test all ECM ground and system ground circuits. The ECM may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Ensure the ground connections are clean and tight 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 **Ground Distribution Schematics** in Wiring Systems.

Temperature Sensitivity	• An intermittent condition may occur only when the component is cold, or only when the component is hot. The heat that affects the circuit can be generated by the engine, a poor connection, or a high electrical load.
	• Information from the customer may help to determine if the trouble follows a pattern that is temperature related. The Freeze Frame/Failure Records or Snapshot data may help with this type of intermittent condition, where applicable.
	• If the intermittent condition is related to heat, review the captured 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 captured data for a relationship with the following:
	  ○ Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
	  ○ The condition only occurs on a cold start.
	  ○ The condition goes away when the vehicle warms up.

Electromagnetic Interference (EMI) and Electrical Noise.	Some electrical components and 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 and 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, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Incorrect installation of aftermarket accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. • An open diode across the A/C compressor clutch and for other open diodes-Some relays may contain a clamping diode or resistor.
Incorrect ECM Programming	• There are only a few situations where reprogramming an ECM is appropriate:

	○ An ECM from another vehicle is installed. ○ Revised software/calibration files have been released for this vehicle. **IMPORTANT:** **DO NOT reprogram the ECM with the SAME software/calibration files that are already present in the ECM. This is not an effective repair for any type of driveability problem.** • Verify that the ECM contains the correct software/calibration. If incorrect programming is found, reprogram the ECM with the most current software/calibration. Refer to **Service Programming System (SPS)** in Programming.
Duplicating Failure Conditions	If the previous tests were not successful, attempt to duplicate and/or capture the failure conditions. Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set. 1. Review and record the Freeze Frame/Failure Records data. 2. Clear any DTCs with a scan tool. 3. Turn OFF the key and wait 15 seconds. 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records. 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 will indicate Ran when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed. An alternate method is to drive the vehicle with a DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs may help you locate the problem.
Scan Tool Snapshot	The scan tool can be set up 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 set up 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.

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 dies.	
Preliminary	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Search for bulletins. • Verify that the driver is using the correct starting procedure as described in the owners manual.
Sensor/System	• Inspect for an engine coolant temperature (ECT) sensor that has shifted in value. Refer to **Temperature vs Resistance** . • Test for proper operation of the manifold absolute pressure (MAP) sensor. Refer to **Altitude vs Barometric Pressure** .
Fuel System	• Verify there is adequate fuel. • Inspect the fuel pump operation. The fuel pump should turn ON for 2 seconds when you turn ON the ignition. Refer to **Fuel Pump Electrical Circuit Diagnosis** . • A faulty in-tank fuel pump check valve allows the fuel in the lines to drain back to the tank after the engine stops. Refer to **Fuel System Diagnosis** . • Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** .

Ignition System	• In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures:
	  ○ **Ignition System Specifications**
	  ○ **Spark Plug Inspection**
	  ○ **Spark Plug Replacement**
	• Remove spark plugs and inspect for the following:
	  ○ Correct heat range
	  ○ Wet plugs
	  ○ Cracks
	  ○ Wear

	○ Improper gap ○ Burned electrodes ○ Heavy deposits ○ Spark plugs are of the correct type. • Inspect for proper secondary ignition voltage output with **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gauge gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Determine the cause of the fouling before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection.
Engine Mechanical	Inspect for the following conditions: • Excessive oil in combustion chamber or leaking valve seals-Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • Low cylinder compression-Refer to **Engine Compression Test** in Engine Mechanical. • Improper valve timing. • Broken or worn valve springs • Combustion chambers for excessive carbon buildup-Clean the chambers using top engine cleaner. Follow the instructions on the can. • Incorrect, worn, or damaged basic engine parts-Inspect the following: ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical. ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
Additional	• Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect the air intake ducts for being collapsed, damaged, loose, improperly installed, or leaking.

SURGES/CHUGGLES

Surges/Chuggles

Inspection/Tests	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 position.	

Preliminary	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Verify the driver understands the operation of the transmission torque converter clutch (TCC) and A/C compressor operation as explained in the owners manual.
Sensor/System	**NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • Inspect for an engine coolant temperature (ECT) sensor that has shifted in value. Refer to **Temperature vs Resistance** . • Inspect for proper operation of the manifold absolute pressure (MAP) sensor. Refer to **Altitude vs Barometric Pressure** .
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Verify that each fuel injector harness is connected to the correct fuel injector or cylinder. Relocate the fuel injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ Purging of a saturated EVAP canister ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** . ○ Leaking fuel injectors-Refer to **Fuel System Diagnosis** . ○ MAP sensor operation-Refer to **Altitude vs Barometric Pressure** . ○ Vacuum hoses that are split, kinked, or improperly connected ○ An air intake duct that is collapsed or restricted ○ An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** .

	• Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Proper MAP sensor operation-Refer to **Altitude vs Barometric Pressure** . ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Ignition System	In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: • **Ignition System Specifications** • **Spark Plug Inspection** • **Spark Plug Replacement** . • Inspect for proper secondary ignition voltage output with the **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Additional Inspections	• Visually and physically inspect vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label. • Inspect the transmission torque converter clutch (TCC) for proper operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission

	-VT25-E or **Torque Converter Diagnosis Procedure** in Automatic Transaxle-5AT. • Test the A/C clutch for proper operation. Refer to **Symptoms - HVAC Systems - Manual** in HVAC Systems - Manual. • Inspect the exhaust system for possible restrictions. Refer to **Restricted Exhaust** in Engine Exhaust.

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 Inspections	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Remove the air filter element and inspect for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** and replace as necessary.
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** o Water intrusion in the HO2S connector o Purging of a saturated EVAP canister o Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . o A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** . o Leaking fuel injectors-Refer to **Fuel System Diagnosis** . o Vacuum hoses that are split, kinked, or improperly connected o An air intake duct that is collapsed or restricted-Refer **Air Cleaner Outlet Resonator Replacement** .

	○ An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	Monitor the knock sensor (KS) system for excessive spark retard activity with a scan tool. Refer to **Scan Tool Data List** .
Ignition System	In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: • **Ignition System Specifications** • **Spark Plug Inspection** • **Spark Plug Replacement** . • Inspect for proper secondary ignition voltage output with **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. • If the spark lugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Engine Mechanical	• Inspect for incorrect camshaft timing. • Inspect for excessive oil in the combustion chambers and leaking valve seals. Refer to **Oil Consumption Diagnosis** in Engine Mechanical.

	• Test the cylinder compression. Refer to **Engine Compression Test** in Engine Mechanical.
	• Inspect for incorrect, worn, or damaged basic engine parts, including the following:
	  ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical.
	  ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.

Additional Inspections	• Inspect the exhaust system for possible restrictions. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the mufflers for heat distress or internal failure. • Inspect the transmission torque converter clutch (TCC) for proper operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission-VT25-E or **Torque Converter Diagnosis Procedure** in Automatic Transaxle-5AT.

DETONATION/SPARK KNOCK

Detonation/Spark Knock

Inspection/Tests	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicles minimum octane requirements. Road test the vehicle and re-evaluate the performance of the vehicle.
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Inspect for the following conditions that may cause the engine to run lean:

	NOTE: **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Inspect for proper operation of the MAP sensor-Refer to **Altitude vs Barometric Pressure** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	Inspect for an engine coolant temperature (ECT) sensor that has shifted in value. Refer to **Temperature vs Resistance** .
Ignition System	• In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: ○ **Ignition System Specifications** ○ **Spark Plug Inspection** ○ **Spark Plug Replacement** • Remove spark plugs and inspect for the following: ○ Correct heat range ○ Wet plugs ○ Cracks ○ Wear ○ Improper gap ○ Burned electrodes ○ Heavy deposits ○ Verify that the spark plugs are of the correct type. • Inspect for proper secondary ignition voltage output with **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gauge gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs.

	• Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for proper ground connection.
Engine Cooling System	Inspect for obvious overheating problems: • Low engine coolant-Refer to **Loss of Coolant** in Engine Cooling. • Faulty thermostat-Refer to **Thermostat Diagnosis** in Engine Cooling. • Restricted air flow to the radiator or restricted coolant flow through the radiator. • Inoperative electric cooling fan - Refer to **Cooling Fan Inoperative (L61) Cooling Fan Inoperative (L66)** in Engine Cooling. • Proper tension on the drive belts-Refer to **Drive Belt Tensioner Diagnosis** in Engine Mechanical. • Correct coolant solution should be a 50/50 mix-Refer to **Cooling System Description and Operation** in Engine Cooling
Engine Mechanical	Inspect for the following engine mechanical problems: • Excessive oil in combustion chamber-Leaking valve seals. Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • High cylinder compression-Refer to **Engine Compression Test** in Engine Mechanical. • Combustion chambers for excessive carbon buildup-Clean the combustion chamber by using top engine cleaner. Follow the instructions on the can. • Incorrect camshaft timing • Inspect for incorrect, worn, or damaged basic engine parts. Inspect the following: o The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical. o The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. o The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical. • Refer to **Symptoms - Engine Mechanical** in Engine Mechanical.
Additional Inspections	Inspect the transmission torque converter clutch (TCC) operation. The TCC applying too soon can cause the engine to spark knock. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission-VT25-E or **Torque Converter Diagnosis Procedure** in Automatic Transaxle-5AT.

HESITATION, SAG, STUMBLE

Hesitation, Sag, Stumble

Inspection/Tests	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 from a stop. May cause the engine to stall if severe enough.	
Preliminary	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
Sensor/System	**NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • Inspect for proper operation of the manifold absolute pressure (MAP) sensor. Refer to **Altitude vs Barometric Pressure** . • Verify that the engine coolant temperature (ECT) sensor has not shifted in value. Refer to **Temperature vs Resistance** .
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Test the fuel injector Refer to **Fuel Injector Coil Test** . • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** o Water intrusion in the HO2S connector o Purging of a saturated EVAP canister o Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . o A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** . o Proper operation of the MAP sensor-Refer to **Altitude vs Barometric Pressure** . o Leaking fuel injectors-Refer to **Fuel System Diagnosis** . o Vacuum hoses that are split, kinked, or improperly connected o An air intake duct that is collapsed or restricted. o An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean:

	NOTE: **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Ignition System	In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: • **Ignition System Specifications** • **Spark Plug Inspection** • **Spark Plug Replacement** • Inspect for proper secondary ignition voltage output with **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Engine Cooling System	Inspect the engine thermostat for proper operation and for correct heat range. Refer to **Thermostat Diagnosis** in Engine Cooling.

CUTS OUT, MISSES

Cuts Out, Misses

Inspections	Action
DEFINITION: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust	

has a steady spitting sound at idle or low speed.	
Preliminary	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the engine control module (ECM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Remove the air filter element and inspect for dirt and for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.
Fuel Systems	• Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Inspect for the following conditions that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** o Water intrusion in the HO2S connector o Purging of a saturated EVAP canister o Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . o A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** . o Leaking fuel injectors-Refer to **Fuel System Diagnosis** . o Proper operation of the MAP sensor-Refer to **DTC P0106** . o Vacuum hoses that are split, kinked, or improperly connected o An air intake duct that is collapsed or restricted o An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** o Water intrusion in the HO2S connector o An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. o Vacuum leaks

	○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Proper operation of the MAP sensor-Refer to **DTC P0106** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	• Verify that the engine coolant temperature (ECT) sensor is not shifted in value. Refer to **Temperature vs Resistance** . • Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to **Scan Tool Data List** . • Inspect for throttle body tampering, excessive deposits, or damage. • Inspect for a vacuum leak. • Inspect the crankcase ventilation system for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical.
Ignition System	• In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: ○ **Ignition System Specifications** ○ **Spark Plug Inspection** ○ **Spark Plug Replacement** • Inspect for proper secondary ignition voltage output with **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gauge gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Engine Mechanical	• Inspect engine mechanical for the following: ○ Compression ○ Sticking or leaking valves ○ Worn camshaft lobes ○ Valve timing ○ Worn rocker arms ○ Broken valve springs

	○ Excessive oil in combustion chamber or leaking valve seals. For more information, refer to one or more of the following procedures in Engine Mechanical: • **Engine Compression Test** • **Symptoms - Engine Mechanical** • **Oil Consumption Diagnosis** • For incorrect, worn, or damaged basic engine parts, inspect the following: ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical. ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical. • Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnosis procedures.
Additional Inspections	• Inspect the exhaust system for possible restrictions. Inspect for the following: ○ Inspect the exhaust system for damaged or collapsed pipes. ○ Inspect the mufflers for heat distress or possible internal failure. ○ Inspect for possible plugged catalytic converters. Refer to **Restricted Exhaust** in Engine Exhaust. • Electromagnetic interference (EMI) can cause an engine misfire condition. A sudden increase in indicated RPM parameter with little change in actual engine RPM change indicates EMI is present. Inspect for high voltage components near ignition control circuits if a condition exists. • Inspect the intake manifold and the exhaust manifold passages for casting flash.

POOR FUEL ECONOMY

Poor Fuel Economy

Inspections	Action
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, fuel economy is noticeably lower than the economy was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .

	• Discuss the following with the owner that may effect fuel economy:
	  ○ Is the A/C ON or the Defroster mode ON full time?
	  ○ Are the tires at the correct pressure?
	  ○ Are the wheels and tires the correct size?
	  ○ Are there excessively heavy loads being carried?
	  ○ Is the acceleration rate too much, too often?
	
	Remove the air filter element and inspect for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.

Fuel System	• Discuss with the owner the type, quality, and alcohol content of the fuel. Oxygenated fuels have lower energy and may deliver reduced fuel economy. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool) Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** and**Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool) Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** . • Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Inspect that each fuel injector harness is connected to the correct fuel injector and cylinder. Relocate the fuel injector harnesses as necessary.

Sensor/System	• Inspect for the following that may cause the engine to run rich:
	
	NOTE:
	Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.
	
	  ○ Water intrusion in the HO2S connector
	  ○ Purging of a saturated EVAP canister
	  ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** .
	  ○ A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** .
	  ○ Leaking fuel injectors-Refer to **Fuel System Diagnosis** .
	  ○ Vacuum hoses that are split, kinked, or improperly connected
	  ○ An air intake duct that is collapsed or restricted
	  ○ An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** .
	• Inspect the air intake system and crankcase for air leaks.
	• Inspect for an engine coolant temperature (ECT) sensor that has shifted in value.

	Refer to **Temperature vs Resistance** . • Inspect the crankcase ventilation system for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Inspect for an inaccurate speedometer. Refer to **Symptoms - Instrument Panel, Gages and Console** in Instrument Panel, Gages and Console. • Monitor the knock sensor (KS) system for excessive spark retard activity with a scan tool. Refer to **Scan Tool Data List** .
Ignition System	In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures: • **Ignition System Specifications** • **Spark Plug Inspection** • **Spark Plug Replacement** • Inspect for proper secondary ignition voltage output with the **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Engine Cooling System	• Inspect the engine coolant level for being low. Refer to **Loss of Coolant** in Engine Cooling. • Inspect the engine thermostat for proper operation and for the correct heat range. Refer to **Thermostat Diagnosis** in Engine Cooling.
Engine Mechanical	• Inspect engine mechanical for the following: o Compression o Sticking or leaking valves o Worn camshaft lobes o Valve timing o Worn rocker arms o Broken valve springs o Excessive oil in combustion chamber or leaking valve seals. For more information, refer to one or more of the following procedures in Engine Mechanical:

	• **Engine Compression Test**
	• **Symptoms - Engine Mechanical**
	• **Oil Consumption Diagnosis**
	• For incorrect, worn, or damaged basic engine parts, inspect the following:
	  ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical.
	  ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
	• Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnosis procedures.

Additional Inspections	• Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label.
	• Inspect the transmission torque converter clutch (TCC) operation. The scan tool should indicate an RPM drop when the system commands the TCC ON.
	• Inspect the exhaust system for a possible restriction. Inspect for the following:
	  ○ The exhaust system for damaged or collapsed pipes
	  ○ The mufflers for heat distress or possible internal failure
	  ○ Possible plugged catalytic converter-Refer to **Restricted Exhaust** in Engine Exhaust.
	• Inspect the brake system for dragging or improper operation. Refer to **Symptoms - Hydraulic Brakes** in Hydraulic Brakes. Verify that the vehicle operator does not drive with a foot on the brake pedal.

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Problem	Causes
Definition: During the fueling process a continual, occasional or no fuel nozzle shut-off condition has occurred.	
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

ROUGH, UNSTABLE, OR INCORRECT IDLE AND STALLING

Rough, Unstable, or Incorrect Idle and Stalling

Inspections	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 Inspections	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems. • Remove and inspect the air filter element for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.
Fuel System	• Inspect the fuel injectors. Refer to **Fuel System Diagnosis** . • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Inspect that each fuel injector harness is connected to the correct injector/cylinder. Relocate fuel injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and**

	Notices. ○ Water intrusion in the HO2S connector ○ Purging of a saturated EVAP canister ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ A leaking fuel pressure regulator-Refer to **Fuel System Diagnosis** . ○ Leaking fuel injectors-Refer to **Fuel System Diagnosis** . ○ Vacuum hoses that are split, kinked, or improperly connected ○ Proper operation of the MAP sensor-Refer to **DTC P0106** . ○ An air intake duct that is collapsed or restricted ○ An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** and **Fuel Injector Balance Test with Tech 2** . ○ Proper operation of the MAP sensor-Refer to **DTC P0106** . ○ Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . ○ Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	• Test for conditions which cause an incorrect idle speed. ○ Throttle body tampering, excessive deposits, or damage ○ Restricted air intake system ○ Large vacuum leak • Inspect the crankcase ventilation system for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Monitor the knock sensor (KS) system for excessive spark retard activity with a scan tool.
Ignition System	• In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures:

	○ **Ignition System Specifications** ○ **Spark Plug Inspection** ○ **Spark Plug Replacement** • Inspect for proper secondary ignition voltage output with the **J 26792** (SA9199Z) Spark Tester. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. • If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs. • Inspect for damaged or misaligned spark plug boots. • Inspect the electronic ignition (EI) module for a proper ground connection. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .
Engine Mechanical	• Inspect engine mechanical for the following: ○ Compression ○ Sticking or leaking valves ○ Worn camshaft lobes ○ Valve timing ○ Worn rocker arms ○ Broken valve springs ○ Excessive oil in combustion chamber or leaking valve seals. For more information, refer to one or more of the following procedures in Engine Mechanical: • **Engine Compression Test** • **Symptoms - Engine Mechanical** • **Oil Consumption Diagnosis** • For incorrect, worn, or damaged basic engine parts, inspect the following: ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical. ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnosis procedures.
Additional	• Inspect the exhaust system for possible restrictions. Inspect for the following:

Inspections	○ The exhaust system for damaged or collapsed pipes ○ The mufflers for heat distress or possible internal failure ○ Possible plugged catalytic converters -Refer to **Restricted Exhaust** in Engine Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine misfire condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM parameter with little change in actual engine RPM change indicates that EMI is present. If a condition exists, inspect routing of secondary ignition wires or high voltage components near the ignition control circuits. • Inspect for faulty motor mounts. Refer to **Engine Mount Inspection** in Engine Mechanical. • Inspect the intake manifold and the exhaust manifold passages for casting flash.

DIESELING, RUN-ON

Dieseling, Run-On

Inspections	Action
DEFINITION: Engine continues to run after key is turned OFF, but runs very rough. If the engine runs smooth, inspect the ignition switch and the ignition switch adjustment.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Beginning in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the engine control module (ECM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
Fuel System	Test the fuel injectors. Refer to **Fuel Injector Coil Test** .

BACKFIRE

Backfire

Inspections	Actions
DEFINITION: Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the engine control module (ECM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** .

	• Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . • Test the fuel injectors. Refer to **Fuel Injector Coil Test** . • Verify that each injector harness is connected to the correct injector or cylinder. Relocate injector harnesses as necessary.
Sensor/System	• Inspect the crankcase ventilation system for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to **Scan Tool Data List** .

Ignition System	• In order to properly inspect the spark plugs or to correct a condition, refer to the following procedures:
	  ○ **Ignition System Specifications**
	  ○ **Spark Plug Inspection**
	  ○ **Spark Plug Replacement**
	• Remove spark plugs and inspect for the following:
	  ○ Correct heat range
	  ○ Wet plugs
	  ○ Cracks
	  ○ Wear
	  ○ Improper gap
	  ○ Burned electrodes
	  ○ Heavy deposits
	  ○ Verify that the spark plugs are of the correct type.
	  ○ Inspect for proper ignition voltage output with **J 26792** (SA9199Z) Spark Tester.
	• An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool.
	• If the spark plugs are found to be fouled, determine the cause before replacing the spark plugs.
	• Inspect for damaged or misaligned spark plug boots.
	• Inspect the electronic ignition (EI) module for a proper ground connection.
	• Monitor the Misfire Current Counters while driving the vehicle in the conditions that the symptom occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** .

Engine Cooling System	• Inspect the engine coolant level for being low. Refer to **Loss of Coolant** in Engine Cooling.

	• Inspect the engine thermostat for proper operation and for the correct heat range. Refer to **Thermostat Diagnosis** in Engine Cooling.

Engine Mechanical	• Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnosis procedures.
	• Inspect engine mechanical for the following:
	  ○ Compression
	  ○ Sticking or leaking valves
	  ○ Worn camshaft lobes
	  ○ Valve timing
	  ○ Worn rocker arms
	  ○ Broken valve springs
	  ○ Excessive oil in combustion chamber or leaking valve seals.
	
	For more information, refer to one or more of the following procedures in Engine Mechanical:
	
	• **Engine Compression Test**
	• **Symptoms - Engine Mechanical**
	• **Oil Consumption Diagnosis**
	• For incorrect, worn, or damaged basic engine parts. Inspect the following:
	  ○ The camshaft-Refer to **Camshaft Cleaning and Inspection** in Engine Mechanical.
	  ○ The cylinder heads-Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ○ The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.

Additional Inspections	• Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label.
	• Inspect the intake manifold and the exhaust manifold passages for casting flash.
	• Inspect the exhaust system for possible restrictions. Inspect the following:
	  ○ Inspect the exhaust system for damaged or collapsed pipes.
	  ○ Inspect the mufflers for heat distress or possible internal failure.
	  ○ Inspect for possible plugged catalytic converter. Refer to **Restricted Exhaust** in Engine Exhaust.
	• Electromagnetic interference (EMI) circuit can cause an engine misfire condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM parameter with little change in actual engine RPM change may indicate that EMI is present. If a problem exists, inspect for high voltage components near the ignition control circuits.

MALFUNCTION INDICATOR LAMP (MIL) INOPERATIVE

Circuit Description

The engine control module (ECM) turns the MIL ON by sending a message on the CAN circuit.

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 ECM.

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.

Malfunction Indicator Lamp (MIL) Inoperative

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Did you perform the Diagnostic System Check-Instrument Cluster in Instrument Panel, Gages, and Console?	-	Go to **Step 3**	Go to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gages, and Console
3	Are there any UXXXX DTCs present?	-	Go to **Diagnostic Trouble Code (DTC) List** in Data Link Communications	Go to **Step 4**
	Replace the IPC. Refer to **Instrument Panel Cluster (IPC)**			

4	**Replacement** in Instrument Panel, Gages, and Console. Did you complete the replacement?	-	Go to **Step 5**	-
5	1. Remove all test equipment. 2. Connect any disconnected components or any disconnected fuses. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and operate the vehicle performance, and driveability. 5. Observe the MIL, the vehicle performance, and the drivebility. Does the vehicle operate correctly, without any MIL illumination and without any stored DTCs?	-	System OK	Go to **Diagnostic Trouble Code (DTC) List**

MALFUNCTION INDICATOR LAMP (MIL) ALWAYS ON

Circuit Description

The engine control module (ECM) turns the MIL ON by sending a request over the CAN line.

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 the 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 no longer present.
- If the MIL is illuminated and then the engine stalls, the MIL will remain illuminated as 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.

Malfunction Indicator Lamp (MIL) Always On

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Control Module (ECM) Connector End Views** or **Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Did you perform the Diagnostic System Check-Instrument Cluster in Instrument Panel, Gages, and Console?	Go to **Step 3**	Go to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gages, and Console
3	Command the malfunction indicator lamp (MIL) ON and OFF with a scan tool. Does the MIL turn ON and OFF when commanded?	Go to **Intermittent Conditions**	Go to **Step 4**
4	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages and Console. Did you complete the replacement?	Go to **Step 5**	-
5	1. Turn the ignition OFF for 30 seconds. 2. Start the engine. Does the vehicle operate correctly without any unwanted MIL illumination, and without any stored DTCs?	System OK	Go to **Diagnostic System Check - Engine Controls**

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 (Side Terminal Battery)** or **Battery Inspection/Test (Top Post Terminal Battery)** 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.

Engine Cranks but Does Not Run

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Does the scan tool display any U-type DTCs?	-	Go to **Diagnostic Trouble Code (DTC) List** in Data Link Communications	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the DTC Information with a scan tool. Does the scan tool display DTCs P0336, P0601, P0604, P0606, P0607, P0602, P1621, P1631, P0641, P0651, P1630, P1632 P1680, P1681 or P1682?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	Does the scan tool display any body control module (BCM) vehicle theft deterrent (VTD) DTCs?	-	Go to **Diagnostic Trouble Code (DTC) List** in Theft Deterrent	Go to **Step 5**
5	Command the fuel pump ON with a scan tool. Does the fuel pump operate?	-	Go to **Step 6**	Go to **Fuel Pump Electrical Circuit Diagnosis**
6	1. Turn OFF the ignition. 2. Remove the ignition coil housing. Refer to **Ignition Coil Housing Replacement** . **IMPORTANT:** **Not grounding the ignition coil housing, may cause erratic spark.** 3. Install a jumper wire with clips on both ends from the top of the ignition control module to ground. 4. Install the **J 36012-A** (J 43883) Ignition Test Wires. 5. Install a **J 26792** (SA9199Z) Spark Tester on #1 spark plug jumper wire. 6. Ground #4 (companion to #1) spark	-		

	plug jumper wire. 7. Crank the engine with the remaining spark plug jumper wires connected. 8. Repeat the above steps by installing the spark tester on #4 and grounding #1. Do the same for #2 and #3 spark plugs. Making sure the companion wire is grounded. Does the spark tester spark on all cylinders?		Go to **Step 7**	Go to **Electronic Ignition (EI) System Diagnosis**
7	1. Turn OFF the ignition. 2. Disconnect an injector connector. 3. Install the **J 34730-405** Injector Test Lamp (Noid Light) to the injector connector. 4. Attempt to start the engine. Does the test lamp blink while the engine is cranking?	-	Go to **Step 8**	Go to **Fuel Injector Circuit Diagnosis**
8	1. Turn OFF the ignition. 2. Install a **SA9127E** Gage Bar Set. Refer to **Fuel Pressure Gage Installation and Removal** . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump ON with a scan tool. Is the fuel pressure within the specified range while the fuel pump is operating?	345-414 kPa (50-60 psi)	Go to **Step 9**	Go to **Fuel System Diagnosis**
	Inspect for the following conditions: • Collapsed air intake duct • Restricted air filter element-Refer to **Air Cleaner Element Replacement** . • Spark plugs for being gas or coolant fouled-Refer to **Spark Plug Inspection** . If the spark plugs are fouled, determine what caused the condition. • Engine mechanical condition, worn timing chain and gears, low compression-Refer to **Symptoms -**			

9	**Engine Mechanical** and **Engine Compression Test** in Engine Mechanical. • Restricted exhaust system-Refer to **Restricted Exhaust** in Engine Exhaust. • An engine coolant temperature (ECT) sensor that has shifted in value-Refer to **Temperature vs Resistance** . • Compare manifold absolute pressure position (MAP) parameter to another vehicle. The parameter should be close in value. Refer to **DTC P0106** . Did you complete the action?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start then continue to run?	-	Go to **Step 11**	Go to **Step 2**
11	1. Allow the engine to reach operating temperature. 2. Observe the DTC information with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

MAIN RELAY DIAGNOSIS

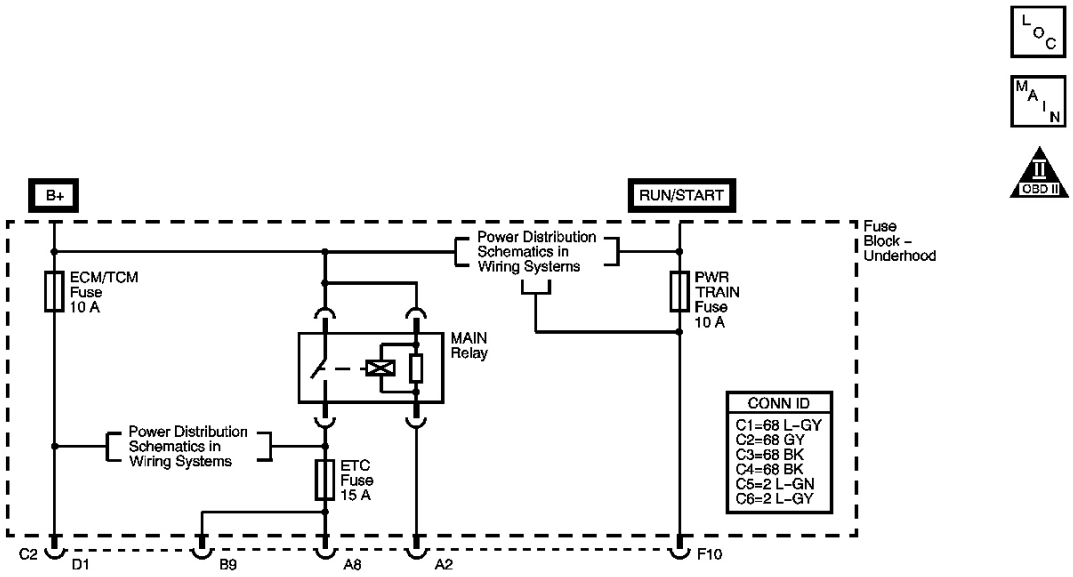

Fig. 1: View Of Main Relay
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The main relay is a normally open relay. The relay armature is held in the open position by spring tension. Battery positive voltage is supplied directly to the relay coil and the armature contact at all times. The engine control module (ECM) supplies the ground path to the relay coil control circuit, via an internal integrated circuit called an output driver module (ODM). When the ECM commands the relay ON, the relay coil creates an electromagnetic field. This electromagnetic field overcomes the spring tension and pulls the armature contact into the stationary contact of the relay load circuit. The closing of the relay contacts allows current to flow from the battery to the following fuses:

- ETC FUSE
- EMISSION FUSE

When the ignition switch is turned to the OFF position, power is interrupted to the output driver module in the ECM, and the relay electromagnetic field collapses. This allows the spring tension to separate the relay armature contact from the relay load circuit contact, which interrupts current flow to the fuses.

If the main relay fails to close the engine will crank and run. The class 2 communications will be available with the use of a scan tool.

The main relay system diagnosis table assumes that the vehicle battery is fully charged. Refer to **Battery Inspection/Test (Side Terminal Battery)** or**Battery Inspection/Test (Top Post Terminal Battery)** in Engine Electrical.

Main Relay Diagnosis

Step	Action	Values	Yes	No
Schematic Reference:Power Distribution Schematics in Wiring Systems and **Engine Controls Schematics** **Connector End View Reference:Engine Control Module (ECM) Connector End Views** , **Power and Grounding Connector End Views** , and **Electrical Center Identification Views** in Wiring Systems				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition with the engine OFF. 2. Remove the underhood fuse block cover. 3. Probe the following fuses with a test lamp that is connected to a good ground: • ETC Fuse • EMISSION Fuse Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate on at least one test point of each fuse?	-	Go to **Step 3**	Go to **Step 10**
3	1. Turn OFF the ignition. 2. Probe both test points of the 15-amp ETC fuse in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate on either test point of the fuse?	-	Go to **Step 4**	Go to **Step 37**
4	1. Turn OFF the ignition. 2. Remove the main relay from the underhood fuse block with the J 43244 Relay Puller Pliers. Refer to **Relay Replacement (Within an Electrical Center)Relay Replacement (Attached to Wire Harness)** in Wiring Systems. 3. Probe both test points of the 15-amp ETC fuse with a test lamp that is connected to a good ground. Does the test lamp illuminate on either test point of the fuse?	-	Go to **Step 5**	Go to **Step 7**
	1. Turn OFF the ignition. 2. Remove the EMISSION fuse from the			

5	underhood fuse block. 3. Probe both test points of the 15-amp ETC fuse with a test lamp that is connected to a good ground. Does the test lamp illuminate on either test point of the fuse?	-	Go to **Step 6**	Go to **Diagnostic System Check - Engine Electrical** in Engine Electrical
6	1. Turn OFF the ignition. 2. Remove the ETC fuse from the underhood fuse block. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 3. Probe the main relay load circuit bus bar terminal in the underhood fuse block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 34**	Go to **Diagnostic System Check - Engine Electrical** in Engine Electrical
7	1. Turn OFF the ignition. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 2. Probe the main relay coil control circuit terminal in the underhood fuse block with a test lamp that is connected to battery positive voltage. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 23**
8	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) electrical connector that contains the relay coil control circuit. Refer to **Engine Control Module (ECM) Replacement** . 3. Probe the main relay coil control circuit terminal in the underhood fuse block center with a test lamp that is connected to battery positive voltage.	-		

	Does the test lamp illuminate?		Go to **Step 9**	Go to **Step 30**
9	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical. 3. Disconnect the underhood fuse block electrical connector that contains the main relay coil control circuit. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. 4. Probe the main relay coil control circuit at the underhood fuse block electrical connector with a test lamp that is connected to battery positive voltage. Does the test lamp illuminate?	-	Go to **Step 31**	Go to **Step 34**
10	1. Turn OFF the ignition. 2. Remove the main relay from the underhood fuse block with the J 43244 . Refer to **Relay Replacement (Within an Electrical Center) Relay Replacement (Attached to Wire Harness)** in Wiring Systems. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 3. Probe the battery positive voltage terminal for the relay coil in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 12**	Go to **Step 11**
11	Probe the mounting stud for the positive battery cable at the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 34**	Go to **Diagnostic System Check - Engine Electrical** in Engine Electrical
12	1. Turn Off the ignition. 2. Probe the relay coil control circuit terminal in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 16**	Go to **Step 13**

13	1. Turn ON the ignition, with the engine OFF. 2. Probe the relay coil control circuit terminal in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 14**	Go to **Step 18**
14	1. Turn OFF the ignition. 2. Disconnect the ECM electrical connector that contains the relay coil control circuit. Refer to **Engine Control Module (ECM) Replacement** . 3. Turn ON the ignition, with the engine OFF. 4. Probe the main relay coil control circuit terminal in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 15**	Go to **Step 30**
15	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical. 3. Disconnect the underhood fuse block electrical connector that contains the main relay coil control circuit. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. 4. Disconnect the main relay coil control circuit terminal from the underhood fuse block electrical connector. Refer to **Pull to Seat Connectors** in Wiring Systems. 5. Connect the electrical connector that contained the main relay coil control circuit to the underhood fuse block. 6. Connect the negative battery cable at the battery. 7. Turn ON the ignition, with the engine OFF. 8. Probe the main relay coil control circuit terminal at the underhood fuse block electrical connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 32**	Go to **Step 34**

16	1. Turn OFF the ignition. 2. Disconnect the ECM electrical connector that contains the relay coil control circuit. Refer to **Engine Control Module (ECM) Replacement** . 3. Probe the main relay control circuit terminal in the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 17**	Go to **Step 30**
17	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical. 3. Disconnect the underhood fuse block electrical connector that contains the main relay coil control circuit. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. 4. Connect the negative battery cable at the battery. 5. Probe the main relay coil control circuit at the underhood fuse block electrical connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 32**	Go to **Step 34**
18	1. Turn OFF the ignition. 2. Probe the battery positive voltage terminal for the main relay armature at the underhood fuse block with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 19**	Go to **Step 34**
19	1. Turn ON the ignition with the engine OFF. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 2. Probe the relay coil control circuit terminal at the underhood fuse block with a test lamp that is connected to battery positive voltage.	-		

	Does the test lamp illuminate?		Go to **Step 22**	Go to **Step 20**
20	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical. 3. Disconnect the underhood fuse block electrical connector that contains the main relay coil control circuit. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. 4. Disconnect the ECM electrical connector that contains the main relay coil control circuit. Refer to **Engine Control Module (ECM) Replacement** . 5. Measure the resistance of the relay coil control circuit from the underhood fuse block electrical connector to the ECM electrical connector with a DMM. Refer to **Troubleshooting with a Digital Multimeter** in Wiring Systems. Does the resistance measure than the specified value?	5 ohm	Go to **Step 33**	Go to **Step 21**
21	Test the main relay coil control bus bar circuit of the underhood fuse block for a high resistance or an open. Refer to **Circuit Testing** in Wiring Systems. Did you find a condition?	-	Go to **Step 34**	Go to **Step 30**
22	1. Turn OFF the ignition. 2. Connect a 20-amp fused jumper wire between the battery positive voltage circuit terminal of the underhood fuse block and the relay load circuit terminal of the underhood fuse block. Refer to **Using Fused Jumper Wires** in Wiring Systems. 3. Probe the following fuses with a test lamp that is connected to a good ground: • ETC Fuse • EMISSION Fuse Does the test lamp illuminate on at least one test point of each fuse?	-	Go to **Step 23**	Go to **Step 34**
23	Measure the resistance from terminal 85 of the relay to terminal 86 with a DMM. Refer to **Troubleshooting with a Digital Multimeter** in	70-		

	Wiring Systems. Does the resistance measure within the specified range?	110ohm	Go to **Step 24**	Go to **Step 35**
24	Measure the resistance from terminal 30 of the relay to terminal 87 with a DMM. Does the DMM display the specified value?	infinity ohm	Go to **Step 25**	Go to **Step 35**
25	Measure the resistance from terminal 30 of the relay to terminal 85 with a DMM Does the DMM display the specified value?	infinity ohm	Go to **Step 26**	Go to **Step 35**
26	Measure the resistance from terminal 85 of the relay to terminal 87 with a DMM. Does the DMM display the specified value?	infinity ohm	Go to **Step 27**	Go to **Step 35**
27	Measure the resistance from terminal 86 of the relay to terminal 87 with a DMM. Does the DMM display the specified value?	infinity ohm	Go to **Step 28**	Go to **Step 35**
28	1. Connect a 20-amp fused jumper wire from the battery positive cable at the battery to relay terminal 85. Refer to **Using Fused Jumper Wires** in Wiring systems. 2. Connect a jumper wire from the negative battery cable at the battery to relay terminal 86. 3. Measure the resistance from terminal 30 of the relay to terminal 87 with a DMM. Does the resistance measure greater than the specified value?	3 ohm	Go to **Step 35**	Go to **Step 29**
29	Test for an intermittent and for a poor connection at the main relay location on the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find a condition?	-	Go to **Step 34**	Go to **Intermittent Conditions**
30	Test for shorted terminals and poor connections at the ECM electrical connectors. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Micro-Pack 100W Connectors** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 37**	Go to **Step 36**
31	Repair the short to ground in the relay coil control circuit between the underhood fuse block and the ECM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 37**	-
32	Repair the short to voltage in the relay coil control circuit between the underhood fuse block and the ECM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 37**	-
	Repair the high resistance or an open in the relay coil			

33	control circuit between the underhood fuse block and the ECM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 37**	-
34	Replace the underhood fuse block. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. Did you complete the replacement?	-	Go to **Step 37**	-
35	Replace the main relay. Refer to **Relay Replacement (Within an Electrical Center)Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	-	Go to **Step 37**	-
36	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 37**	-
37	1. Reassemble the vehicle as necessary. 2. Replace any open fuses. 3. Clear any DTCs with a scan tool. 4. Start the engine. 5. Operate the vehicle in order to verify the repair. Did you correct the condition?	-	Go to **Step 38**	Go to **Engine Cranks but Does Not Run**
38	Observe the capture info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

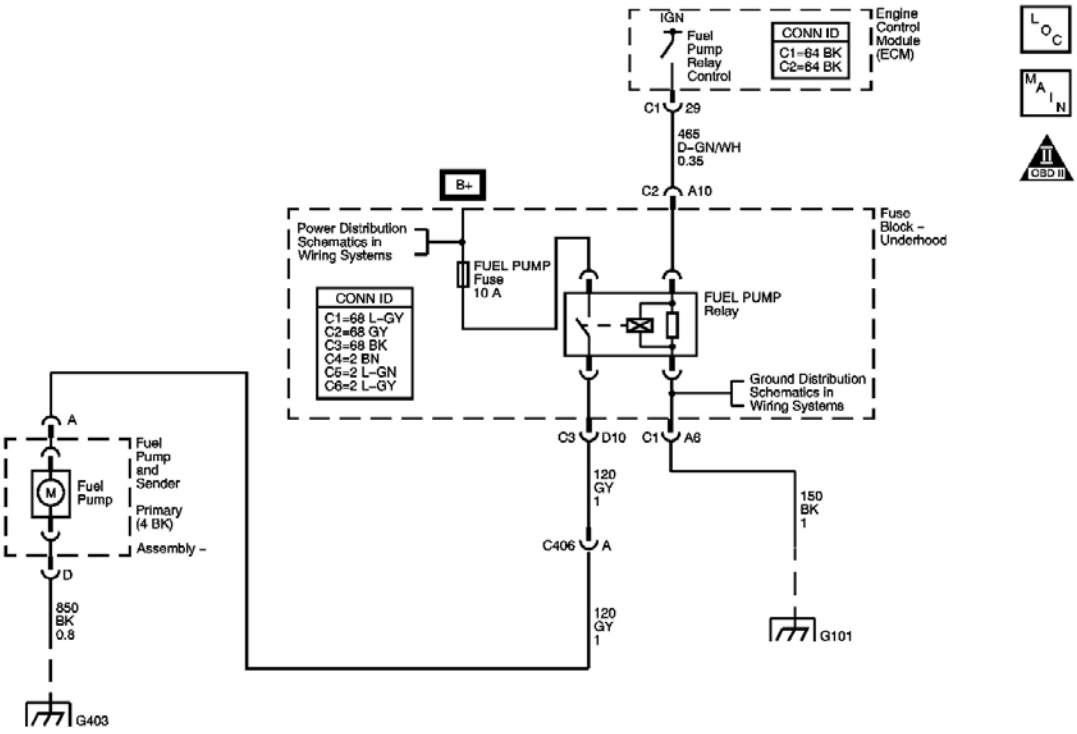

Fig. 2: View Of Fuel Pump Electrical Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

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

Fuel Pump Electrical Circuit Diagnosis

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool.		

	3. Repeat the commands as necessary. Does the fuel pump turn ON and OFF?	Go to **Intermittent Conditions**	Go to **Step 3**
3	Command the fuel pump relay ON and OFF with a scan tool. Do you hear the fuel pump relay 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. Remove 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. Refer to **Probing Electrical Connectors** in Wiring Systems. 5. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to **Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to **Step 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 **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 29**	Go to **Step 28**
8	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 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. Remove 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	Inspect the fuel pump fuse. Is the fuel pump fuse open?	Go to **Step 12**	Go to **Step 15**

12	1. Disconnect the inline harness connector for the fuel senders. Refer to **Inline Harness Connector End Views** in Wiring Systems. 2. Test the supply voltage circuit of the fuel pump for a short to ground between the fuel pump relay and inline harness connector. 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. Refer to **Fuel Tank Replacement** . 2. Inspect the fuel sender harness on top of the fuel tank for the following conditions: • Any damage to the harness • A short to ground in the supply voltage circuit of the fuel pump-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 14**
14	1. Connect all disconnected electrical components. 2. Install a new fuel pump fuse. 3. Command the fuel pump relay ON with a scan tool. 4. Inspect the fuel pump fuse. Is the fuel pump fuse open?	Go to **Step 26**	Go to **Intermittent Conditions**
15	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the fuel pump relay, switch side, with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 16**	Go to **Step 25**
16	Connect a 10-amp fused jumper wire between the battery voltage circuit of the fuel pump relay and the supply voltage circuit of the fuel pump. Does the fuel pump operate?	Go to **Step 21**	Go to **Step 17**
	1. Disconnect the inline harness connector for the fuel		

17	senders. Refer to **Inline Harness Connector End Views** in Wiring Systems. 2. Test the supply voltage circuit of the fuel pump for an open or high resistance between the fuel pump relay and the inline harness connector. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 29**	Go to **Step 18**
18	**IMPORTANT:** **Inspect the ground circuit for proper torque, 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 inline harness connector and ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 29**	Go to **Step 19**
19	Test for an intermittent and for a poor connection at the inline harness connector of the fuel senders. 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 29**	Go to **Step 20**
20	1. Lower the fuel tank. Refer to **Fuel Tank Replacement** . 2. Inspect the fuel sender harness on top of the fuel tank for the following conditions: • A damaged harness • An open circuit-Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 29**	Go to **Step 26**
21	Test for an intermittent and for a poor connection at the fuel pump relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 29**	Go to **Step 27**
22	Test for an intermittent and for a poor connection at the engine control module (ECM). 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 29**	Go to **Step 28**
23	Repair the short to voltage in the supply voltage circuit of the fuel pump. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 29**	-
	Repair the open or high resistance in the ground circuit of		

24	the fuel pump relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 29**	-
25	Repair the open in the battery voltage circuit of the fuel pump relay. Refer to **Wiring Repairs** 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 primary fuel tank module. Refer to **Fuel Tank Module Replacement - Primary** . 2. Replace the fuel pump fuse if necessary. Did you complete the replacement?	Go to **Step 29**	-
27	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 29**	-
28	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 29**	-
29	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

FUEL SYSTEM DIAGNOSIS

System Description

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

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

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

The primary fuel tank module also contains a primary jet pump and a secondary jet pump. Fuel pump flow loss,

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

Fuel System Diagnosis

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Inspect the fuel system for damage or external leaks before proceeding with this diagnostic.** 1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON with a scan tool. Does the fuel pump operate?	-	Go to **Step 3**	Go to **Fuel Pump Electrical Circuit Diagnosis**
3	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the **SA9127E** Gage Bar Set with the Fuel Pressure Adapter and the Drain Hose. Refer to **Fuel Pressure Gage Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **DO NOT start the engine.** 5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage with the fuel pump commanded ON. Is the fuel pressure within the specified range?	345-414 kPa (50-60 psi)	Go to **Step 4**	Go to **Step 7**
4	**IMPORTANT:** **The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.**	100 kPa (14.5 psi)		

	Monitor the fuel pressure gage for 5 minutes.Does the fuel pressure decrease by more than the specified value?		Go to **Step 6**	Go to **Step 5**
5	1. Operate the vehicle within the conditions to reproduce the original symptoms. 2. Monitor the O2 and the Fuel Trim parameters with a scan tool. Do the scan tool parameters indicate a lean condition?	-	Go to **Step 8**	Go to **Symptoms - Engine Controls**
6	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Remove the fuel pressure gage from the fuel pressure test connection. 4. Disconnect the chassis fuel hose from the engine compartment fuel pipe. 5. Connect the fuel feed hose to the inlet side of **SA9127E-7** Fuel Pressure/Flow Adapter using the **J 43937** 3/8 inch Male Fuel Pressure Adapter Line. 6. Connect the return hose from the **SA9127E-7** to the outlet side of **SA9127E-7** . 7. Place the other end of the return hose into the fuel filler pipe. 8. Connect the fuel pressure gage to the **SA9127E-7** . 9. Close the valve on the **SA9127E-7** . 10. Turn ON the ignition, with the engine OFF. 11. Command the fuel pump relay ON for a minimum of 10 seconds with a scan tool. 12. Record the fuel pressure. 13. Command the fuel pump relay OFF. 14. Monitor the fuel pressure gage for 5 minutes. Does the fuel pressure decrease by more than the specified value?	55 kPa (8 psi)	Go to **Step 11**	Go to **Step 9**
7	Is the fuel pressure more than the specified value?	414 kPa (60 psi)	Go to **Step 11**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Remove the fuel pressure gage from the fuel			

8	pressure test connection. 4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 5. Disconnect the chassis fuel feed pipe at the fuel tank pipe. 6. Connect the inlet side of **SA9127E-7** to the fuel tank pipe using the **J 43937** 3/8 inch Female Fuel Pressure Adapter Line. 7. Place the return hose from the **SA9127E-7** into the fuel filler pipe. 8. Connect the fuel pressure gage to the **SA9127E-7** . 9. Open the valve on the **SA9127E-7** . 10. Turn ON the ignition, with the engine OFF. 11. Command the fuel pump relay ON for a minimum of 10 seconds with a scan tool. Is the fuel pressure more than the specified value?	379 kPa (55 psi)	Go to **Step 10**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Open the valve on the **SA9127E-7** . 3. Remove the **SA9127E-7** . 4. Connect the chassis fuel hose to the engine compartment fuel pipe. 5. Raise the fuel rail, with the fuel line connected. 6. Turn ON the ignition, with the engine OFF. 7. Command the fuel pump relay ON with a scan tool. 8. Locate and replace the leaking fuel injector. Did you complete the replacement?	-	Go to **Step 12**	-
10	Replace the chassis fuel feed pipe. Refer to **Fuel Hose/Pipes Replacement - Chassis** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the primary fuel tank module. Refer to **Fuel Tank Module Replacement - Primary** . Did you complete the replacement?	-	Go to **Step 12**	-
12	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 pulse 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 too 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 to 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 customer's concern. A fuel injector condition may only be apparent at a certain temperature, or under certain conditions.

Fuel Injector Coil Test

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the ECT Sensor parameter with a scan tool. Is the ECT Sensor parameter within the specified range?	10-32°C (50-90° F)	Go to **Step 3**	Go to **Step 4**
3	1. Remove the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** . 2. Measure the resistance of each fuel injector with a DMM. Refer to **Testing for Continuity** in Wiring Systems. Is the resistance within the specified range for each injector?	11-14 ohm	Go to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2**	Go to **Step 6**
	1. Remove the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** . 2. Measure the resistance of each fuel injector with a DMM. Refer to **Testing for Continuity** in Wiring Systems.			

4	3. Record each fuel injector resistance value. 4. Subtract the lowest resistance value from the highest resistance value. Is the difference equal to, or less than, the specified value?	3 ohm	Go to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2**	Go to **Step 5**
5	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 individual fuel injector resistance value from the average resistance value. 4. Compute the difference between the highest individual fuel injector resistance value and the average resistance value. 5. Replace the fuel injector that displays the greatest resistance difference above or below the average. Did you complete the replacement?	-	Go to **Step 7**	-
6	Replace the fuel injector or fuel injectors with resistance that is out of the specified range. Did you complete the replacement?	11-14 ohm	Go to **Step 7**	-
7	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

System Description

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

Fuel Injector Balance Test Example (Actual Results May Vary)

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

Test Description

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

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

Fuel Injector Balance Test with Special Tool

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
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 Sensor parameter with a scan tool.Is the ECT Sensor parameter less than the specified value?	94°C (201°F)	Go to **Step 4**	-
4	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the fuel pressure gage. Refer to **Fuel Pressure Gage Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **DO NOT start the engine.**	345-414 kPa (50-60 psi)		

	5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage with the fuel pump operating. 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 fuel pressure gage for 5 minutes.Does the fuel pressure decrease by more than the specified value?	100 kPa (14.5 psi)	Go to **Fuel System Diagnosis**	Go to **Step 6**
6	**NOTE:** **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** 1. Remove the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** . 2. Connect the **J 39021** or the **SA9182E** Electronic Fuel Injector Tester to a fuel injector with the **J 39021-380** or the **SA9182E** (SA9182E-20 Injector Tester Adapter). 3. Set the selector switch on the fuel injector tester to the Balance Test 0.5-2.5 amp position (J 39021) or the 50 pulses/10 ms position (SA9182E). 4. Command the fuel pump relay ON and then OFF with a scan tool. 5. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. This is the first pressure reading. **IMPORTANT:** **The fuel pressure may rise after the fuel injector stops pulsing. Record the fuel pressure value immediately after the fuel injector stops pulsing. DO NOT record the higher fuel pressure value.** 6. Energize the fuel injector by depressing the	20 kPa (3 psi)		

	Push to Start Test button on the fuel injector tester. 7. Record the fuel pressure indicated by the fuel pressure gage after the fuel injector has stopped pulsing. This is the second pressure reading. 8. Repeat steps 2 through 7 for each fuel injector. 9. Subtract the second pressure reading from the first 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. Is the difference between any individual pressure drop and the average pressure drop more than the specified value?		Go to **Step 7**	Go to **Symptoms - Engine Controls**
7	Replace the fuel injectors. Refer to **Fuel Injectors and Fuel Rail Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Symptoms - Engine Controls**

FUEL INJECTOR BALANCE TEST WITH TECH 2

System Description

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

Fuel Injector Balance Test Example (Actual Results May Vary)

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

Test Description

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

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

Fuel Injector Balance Test with Tech 2

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
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 Sensor parameter with a scan tool.Is the ECT Sensor parameter less than the specified value?	94°C (201°F)	Go to **Step 4**	-
4	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the fuel pressure gage. Refer to **Fuel Pressure Gage Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** • **The fuel pump relay may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.** • **DO NOT start the engine.** 5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage, with the fuel pump operating.	345-414 kPa (50-60 psi)		Go to **Fuel System**

	Is the fuel pressure within the specified value?		Go to **Step 5**	**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 fuel pressure gage for 5 minutes.Does the fuel pressure decrease by more than the specified value?	100 kPa (14.5 psi)	Go to **Fuel System Diagnosis**	Go to **Step 6**
6	**NOTE:** **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** 1. With a scan tool, select the Fuel Injector Balance Test function, within the Special Functions menu. 2. Select an injector to be tested. 3. Press Enter. This will prime the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. 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 fuel pressure gage after the fuel injector has stopped pulsing. 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	20 kPa (3 psi)		

	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. Is the difference between any individual pressure drop and the average pressure drop more than the specified value?		Go to **Step 7**	Go to **Symptoms - Engine Controls**
7	Replace the fuel injectors. Refer to **Fuel Injectors and Fuel Rail Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Symptoms - Engine Controls**

FUEL INJECTOR CIRCUIT DIAGNOSIS

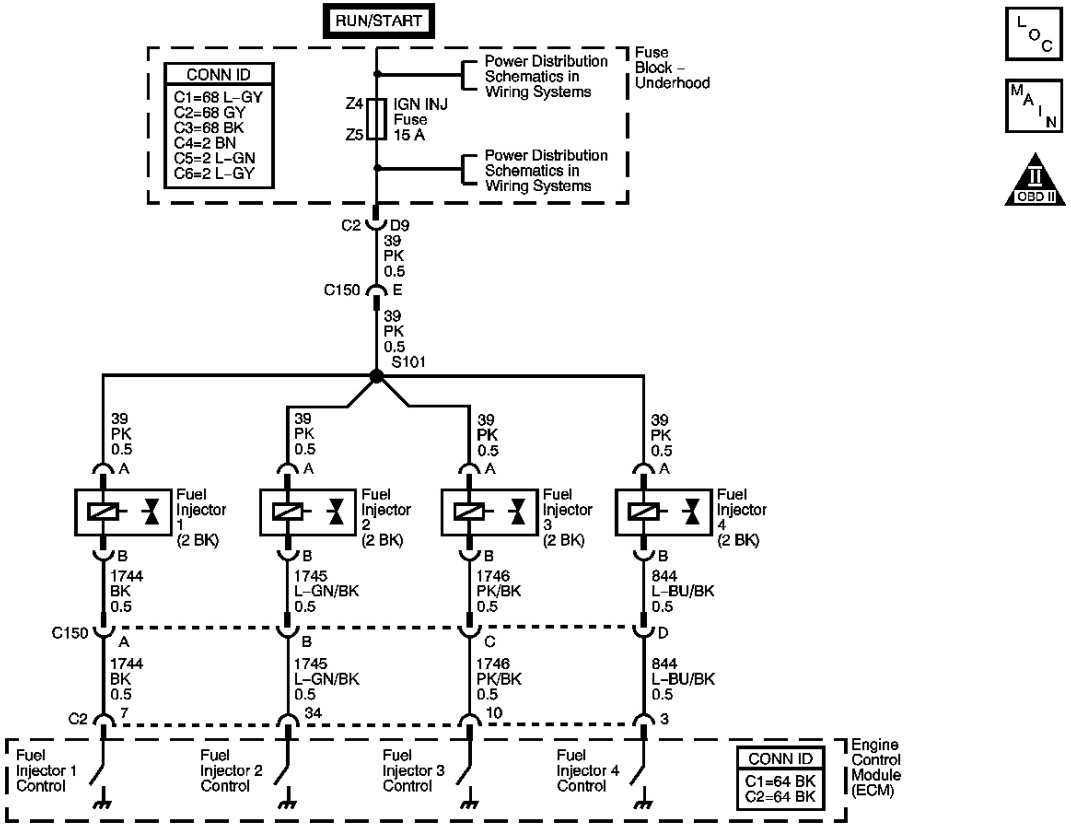

Fig. 3: View Of Fuel Injector Circuit

Courtesy of GENERAL MOTORS CORP.

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver.

Diagnostic Aids

- 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** .

Fuel Injector Circuit Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0201, P0202, P0203, or P0204 set?	-	Go to **DTC P0201-P0204**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Remove the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** . 3. Disconnect the harness connector of a fuel injector. 4. Turn ON the ignition, with the engine OFF. 5. Probe the ignition 1 voltage circuit of a fuel injector, fuse side, with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 4**	Go to **Step 5**
4	1. Remove the IGN/INJ fuse. 2. Measure the resistance from the IGN/INJ fuse to the ignition 1 voltage circuit terminal of a fuel injector with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance more than the specified value?	5 ohm	Go to **Step 6**	Go to Diagnostic Aids
	Repair the open in the ignition 1 voltage circuit of the fuel injectors. Refer to **Wiring Repairs** in Wiring			

5	Systems. Did you complete the repair?	-	Go to **Step 7**	-
6	Repair the high resistance in the ignition 1 voltage circuit of the fuel injectors. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

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, if more than the calibrated amount, when the evaporative emission (EVAP) diagnostics complete one test cycle. The malfunction indicator lamp (MIL) will illuminate after the EVAP diagnostics have failed two test cycles.

Diagnostic Aids

- Operate the vehicle under the condition of the customer 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 the EVAP purge is enabled, all fuel vapor release would be eliminated.
- Movement of the EVAP pipes or the fuel pipes may help find an intermittent condition.
- If the fuel level is low, a liquid fuel leak may not be evident.

Test Description

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

4: This step tests for fuel leaks below the fuel tank fuel level.

5: This step tests for 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 - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	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.**		

2	1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 2. Inspect the fuel tank and the 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 relay 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**
4	1. Turn OFF the ignition. 2. Install the **J 41413-200** (J 41413-100) Evaporative Emissions System Tester (EEST) and the **GE-41415-50** Interrupted Thread Fuel Tank Cap Adapter. 3. Test for a fuel tank leak referring to the J 41413-210 Operation Manual. **IMPORTANT:** **If the floating indicator registers any flow after stabilizing, a leak is evident.** 4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** 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** (J 41413-100) and the J 41413-210 Operation Manual, introduce smoke into the evaporative emission (EVAP) system. **IMPORTANT:** **It may be necessary to partially lower the fuel tank. Refer to Fuel Tank Replacement .** 2. Inspect for leaks in any of the following locations: • The fuel tank-Refer to **Fuel Tank Replacement** . • The primary fuel tank module, the fuel tank module seal, the fuel pipe, and the EVAP pipes-Refer to **Fuel Tank Module Replacement - Primary** . • The secondary fuel tank module and the fuel tank module seal-Refer to **Fuel Tank Module Replacement -**		

	Secondary . • The fuel tank pressure (FTP) sensor seal-Refer to **Fuel Tank Pressure Sensor Replacement** . • The fuel fill pipe and hose-Refer to **Filler Tube Replacement** . Did you find and correct the condition?	Go to **Step 8**	Go to Diagnostic Aids
6	Replace the fuel tank. Refer to **Fuel Tank Replacement** . Did you complete the replacement?	Go to **Step 8**	-
7	Replace the leaking fuel pipe. Did you complete the replacement?	Go to **Step 8**	-
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**

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

Test 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.

Alcohol in Fuel Testing Procedure

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

1. Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
2. Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.
3. Shake the cylinder vigorously for 10-15 seconds.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10-15 seconds.
6. Put the cylinder on a level surface for approximately 5 minutes in order to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

Particulate Contaminants in Fuel Testing Procedure

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

1. Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel.
2. Place the container on a level surface for approximately 5 minutes in order to allow settling of the particulate contamination. Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles.
3. Observe the fuel sample. If any physical contaminants or water are present, clean the fuel system. 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.
2. If water appears in the fuel sample, clean the fuel system. Refer to **Fuel System Cleaning** .
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

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

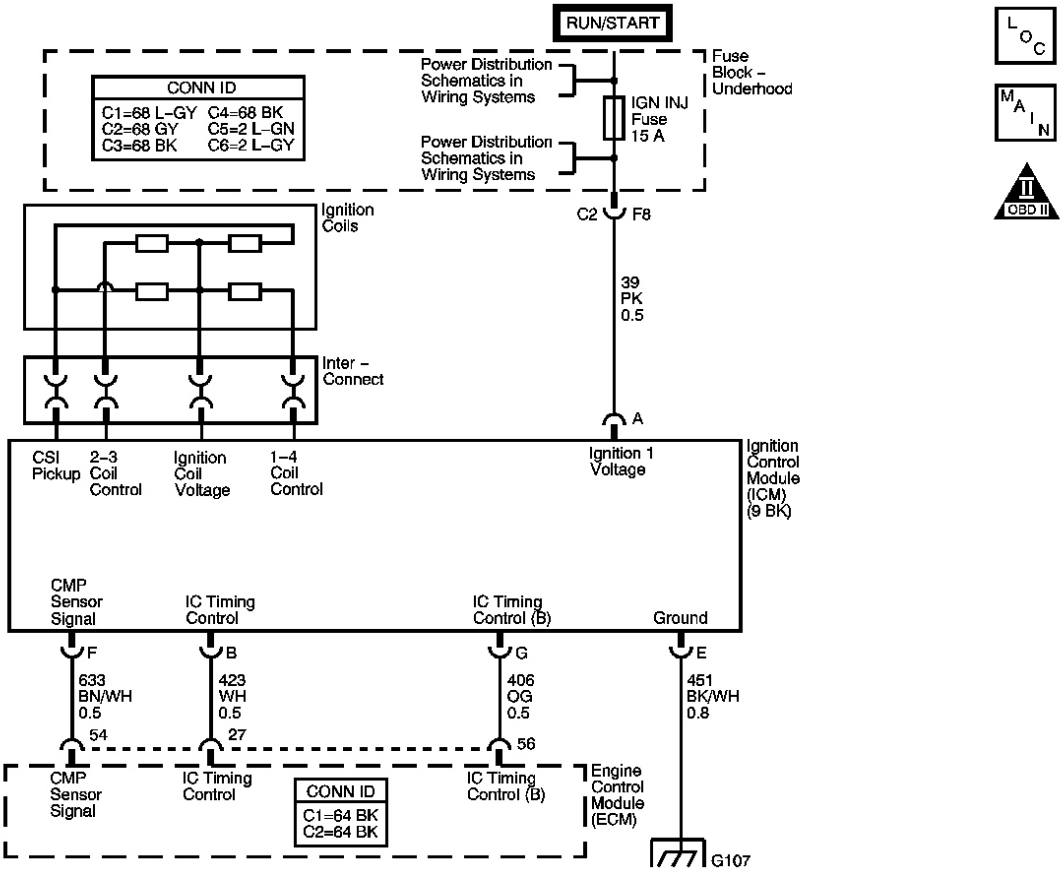

Fig. 4: View Of Electronic Ignition (EI) System
Courtesy of GENERAL MOTORS CORP.

Circuit Description

Each ignition coil supplies secondary voltage to a pair of spark plugs. This is called a waste spark ignition system. The engine control module (ECM) supplies a signal on each of the ignition control (IC) timing control circuits to the ignition control module (ICM). The ICM fires the correct ignition coil at the correct time based on the signals. The ICM detects if cylinder 1 or cylinder 3 is on the compression stroke by sensing the secondary voltage and polarity of each side of the ignition coil. The ICM detects this voltage with sensing

circuitry integrated into each ignition coil. The higher voltage is on the compressing cylinder. This is called compression sense ignition. The ICM provides a synthesized cam signal to the ECM based on these inputs. The ECM uses the cam signal to synchronize fuel injection.

This system consists of the following circuits:

- Ignition voltage
- Ground
- Camshaft position (CMP) sensor signal
- IC timing control for cylinders #1 and #4
- IC timing control B circuit for cylinders #2 and #3

Electronic Ignition (EI) System Diagnosis

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Control Module (ECM) Connector End Views** or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Crank the engine. 2. Observe the CKP Active Counter on the scan tool. Does the CKP Active Counter increment?	-	Go to **Step 3**	Go to **Crankshaft Position Sensor (CKP) System Diagnosis**
3	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Remove the ignition coil housing. Refer to **Ignition Coil Housing Replacement** . 4. Install the **J 36012-A** (J 43883) Ignition System Diagnostic Harness. 5. Install a **J 26792** (SA9199Z) Spark Tester on #1 spark plug jumper wire. 6. Connect the #4 jumper wire to a good ground. 7. Connect the other jumper wires from the 2-4 ignition coil to the respective cylinders. 8. Observe the spark tester. 9. Crank the engine. 10. Repeat the procedure for the remaining cylinders Does the spark tester spark on all cylinders?	-	Go to **Step 6**	Go to **Step 4**
	Is the no spark condition only present on one cylinder?		Go to	

4		-	**Step 16**	Go to **Step 5**
5	Is the no spark condition only present on companion cylinders 1-4 or 2-3?	-	Go to **Step 12**	Go to **Step 8**
6	Does the spark tester indicate a bright blue spark on all cylinders?	-	Go to **Step 7**	Go to **Step 16**
7	1. Remove the spark plugs. 2. Examine the spark plugs for any abnormal conditions or damage. Refer to **Spark Plug Inspection** . Are the spark plugs in good condition?	-	System OK	Go to **Step 23**
8	1. Turn OFF the ignition. 2. Disconnect the harness connector of the ICM. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp from the ignition voltage circuit of the ICM to a good ground. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 19**
9	Connect a test lamp from the ignition voltage circuit to the ground circuit of the ICM. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 20**
10	1. Turn OFF the ignition. 2. Remove the fuse that supplies ignition voltage to the ICM. 3. Measure the resistance of the ignition voltage circuit of the ICM from the harness connector of the ICM to the fuse. Is the resistance less than the specified value?	3 ohm	Go to **Step 11**	Go to **Step 21**
11	Measure the resistance of the ground circuit of the ICM from the harness connector of the ICM to a good ground. Is the resistance less than the specified value?	3 ohm	Go to **Step 12**	Go to **Step 22**
12	1. Turn OFF the ignition. 2. Remove the ICM from the ignition coil housing. Refer to **Ignition Control Module Replacement** . 3. Connect the harness connector of the ICM. 4. Confirm that the interconnect is connected to the ICM. 5. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **If using a different test lamp, the bulb resistance needs to be 4 ohms or less.**	-		

	6. Connect a **J 34730-405** Injector Test Lamp (Noid Light) from the ignition voltage circuit at the ICM interconnect to a good ground. For the circuit identification in the ICM interconnect, refer to **Electronic Ignition (EI) System Description** . Does the test lamp illuminate?		Go to **Step 13**	Go to **Step 17**
13	1. Connect a **J 34730-405** between the ignition voltage circuit and the IC timing control circuit for the inoperative ignition coil. For the circuit identification in the ICM interconnect, refer to **Electronic Ignition (EI) System Description** . 2. Crank the engine. Does the test lamp flash?	-	Go to **Step 16**	Go to **Step 14**
14	1. Leave the **J 34730-405** connected between the ignition voltage and the IC timing control circuit for the inoperative ignition coil. 2. Turn OFF the ignition. 3. Disconnect the harness connector of the ICM. 4. Connect jumper wires from the harness connector of the ICM to the corresponding terminals of the ICM. 5. Using the jumper wires, exchange the IC timing control circuits of the ICM. 6. Crank the engine. Does the test lamp flash?	-	Go to **Step 15**	Go to **Step 17**
15	Test the IC timing control circuit for the affected ignition coil of the ICM for one of the following conditions: • Open • Short to voltage • Short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 27**	Go to **Step 18**
16	Test for shorted terminals or a poor connection at the ignition coil housing. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-	Go to	

	Did you find and correct the condition?		**Step 27**	Go to **Step 24**
17	Test for shorted terminals or 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 27**	Go to **Step 25**
18	Test for shorted terminals or a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 27**	Go to **Step 26**
19	Repair an open or short to ground in the ignition voltage circuit of the ICM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 27**	-
20	Repair an open in the ground circuit of the ICM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 27**	-
21	Repair the high resistance in the ignition voltage circuit of the ICM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 27**	-
22	Repair the high resistance in the ground circuit of the ICM. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 27**	-
23	Replace the spark plugs. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 27**	-
24	Replace the ignition coil housing. Refer to **Ignition Coil Housing Replacement** . Did you complete the replacement?	-	Go to **Step 27**	-
25	Replace the ICM. Refer to **Ignition Control Module Replacement** . Did you complete the replacement?	-	Go to **Step 27**	-
26	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 27**	-
27	1. Turn the ignition OFF for 30 seconds. 2. Start the engine and operate the vehicle. 3. Observe the MIL, vehicle performance, and driveability. Does the vehicle operate normally?	-	System OK	Go to **Step 3**

CRANKSHAFT POSITION SENSOR (CKP) SYSTEM DIAGNOSIS

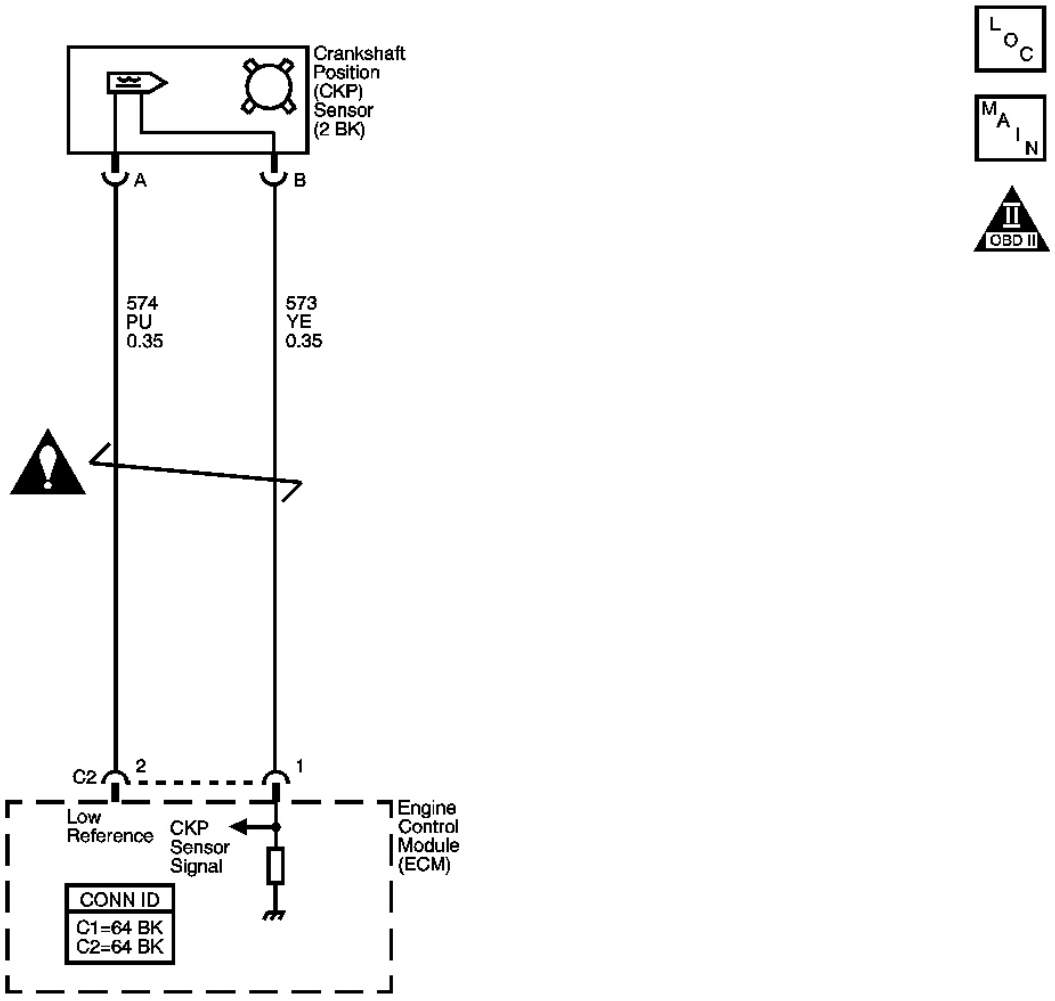

Fig. 5: View Of Crankshaft Position Sensor (CKP) System
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The crankshaft position (CKP) sensor is a variable reluctance sensor. The crankshaft position (CKP) sensor indicates the crankshaft speed and position. The CKP sensor produces an AC voltage of different amplitude and frequency. The frequency depends on the velocity of the crankshaft. The AC voltage output depends on the crankshaft position and battery voltage. The CKP sensor works in conjunction with a 7X reluctor wheel attached to the crankshaft. The CKP sensor connects to the engine control module (ECM) through the following circuits:

- The CKP sensor signal
- The low reference

Crankshaft Position Sensor (CKP) System Diagnosis

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Attempt to start the engine. Does the engine start and run?	-	Go to **Step 3**	Go to **Step 4**
3	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM). 3. Measure the resistance between the signal circuit and the low reference circuit of the crankshaft position (CKP) sensor with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance within the specified range?	500-900 ohm	Go to **Intermittent Conditions**	Go to **Step 11**
4	1. Turn OFF the ignition. 2. Crank the engine. 3. Observe the CMP Resync Counter parameter with a scan tool. Does the CMP Resync Counter increment?	-	Go to **Step 12**	Go to **Step 5**
5	Test the signal circuit for the following conditions: • A short to voltage • An open • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 6**
6	Test the low reference circuit for the following conditions: • A short to voltage • An open • High resistance • The CKP sensor circuits shorted together			

	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 13**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 8**
8	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 13**	Go to **Step 9**
9	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Visually inspect the CKP sensor for the following conditions: • Physical damage • Excessive play or looseness • Improper installation • Foreign material passing between the CKP sensor and the reluctor wheel • Excessive air gap between the CKP sensor and the reluctor wheel • Electromagnetic interference in the CKP sensor circuits Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
10	Inspect the CKP reluctor wheel for the following conditions: • Physical damage • Excessive end play or looseness • Improper installation Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
11	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** .	-		

	Did you complete the replacement?		Go to **Step 13**	-
12	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Turn OFF the ignition for 30 seconds. 2. Start the engine and operate the vehicle. 3. Observe the MIL, vehicle performance, and driveability. Does the vehicle operate normally, with no MIL illumination?	-	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 I/M emission inspection in order to renew license plates. This is accomplished by viewing the I/M System Status display on a scan tool. Using a scan tool, the technician can observe the I/M System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements.

Conditions for Updating the I/M System Status

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

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

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

Monitored Emission Control Systems

The OBD II System monitors all emission control systems that are on-board. 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
- 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)
- The AIR System

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 **Diagnostic System Check - Engine Controls** . **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 I/M readiness. 2. Perform any reprogramming or repairs indicated by the service bulletins.	Go to **Inspection/Maintenance**	

	Was a reprogramming or repair service required?	**(I/M) Complete System Set Procedure**	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 **Inspection/Maintenance (I/M) Complete System Set Procedure**	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 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 procedure when more than one of the I/M System Status indicators are set to NO.

Conditions for Running

Cold Start

- The barometric pressure (BARO) is more than 75 kPa.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The difference between the IAT and the ECT is 8°C (14°F) or less.
- The battery voltage is between 11-16 volts.
- The fuel level is between 1/4 and 3/4.

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 procedures 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 Catalyst Tests. This test runs during the idle period immediately following a cruise period that meets a minimum calibrated RPM and time period.

6: 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
1	Did you perform the Inspection/Maintenance (I/M) System Check?	-	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
2	**IMPORTANT:** **Whenever the ignition is turned ON, ignition positive voltage is supplied to the 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 the engine to	2 minutes		

	idle. 7. Allow the engine to idle for the specified time. Is the action complete?		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 90 km/h (56 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. Continue operation under these conditions for an additional 6 minutes. Is the action complete?	-	Go to **Step 4**	-
4	**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 75-89 km/h (45-55 mph) with this speed maintained for 2 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 or manual transmission in neutral with the clutch pedal depressed Is the action complete?	-	Go to **Step 5**	-
	Observe the I/M System Status display with a			

5	scan tool. Did all of the I/M System Status indicators update to YES?	-	Go to **Step 6**	Go to the I/M System Set Procedure for the systems that have not passed
6	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**	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
Catalyst	**DTC P0420**
EVAP	**DTC P0442** **DTC P0446** **DTC P0455** **DTC P0496**
Oxygen Sensor	**DTC P0133** **DTC P0136** **DTC P0140** **DTC P1133** **DTC P1134**
Oxygen Sensor Heater	**DTC P0135 or P0141**

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

Description

The purpose of this test is to satisfy the enable criteria necessary to execute 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. 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 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 (BARO) is more than 72 kPa.
- Engine coolant is at operating temperature, 75-125°C (167-257°F).
- The intake air temperature (IAT) is between -20 to +80°C (-4 to +176°F).
- The engine is in Closed Loop fuel control.
- The engine has run for 6-8 minutes off idle.

- The battery voltage is between 9-16 volts.

Diagnostic Aids

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 an A/C compressor clutch turning ON, may cause the test to abort.

Inspection/Maintenance (I/M) Catalyst 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 **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 the engine to idle. **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:** 4. Acceleration at part throttle to 90 km/h (56 mph) with this speed maintained for 5 minutes. 5. Deceleration to 0 km/h (0 mph). 6. Engine idling for 2 minutes while the following criteria is maintained: • Service brake depressed • Automatic transmission in Drive	-		

	or manual transmission in Neutral with the clutch pedal depressed 7. 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**	Go to **Step 4**
4	1. Refer to **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. This may take up to 2 hours. 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 **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) EVAPORATIVE EMISSION (EVAP) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute 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 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. Performing a visual inspection prior to running the EVAP test may prevent having to repeat the test. 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 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The fuel level is between 1/4 and 3/4.
- The battery voltage is between 11-16 volts.
- The engine is in Closed Loop fuel control.
- The vehicle has been driven for 17 minutes.

Diagnostic Aids

Extreme high or low ambient temperatures may prevent the EVAP System Tests from initiating. Performing a visual inspection prior to running the test may prevent having to repeat the test. A loose fuel cap may cause a test to abort or fail and prevent the I/M System Status from updating. A failed or aborted test will require the vehicle to cool down in order to meet the enable criteria to run another test.

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 an A/C compressor clutch turning ON, may cause the test to abort.

Inspection/Maintenance (I/M) Evaporative Emission (EVAP) 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 **Inspection/Maintenance (I/M) System Check**
	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g.,			

2	A/C, blower fan, etc. **IMPORTANT:** **Once the engine is started, DO NOT turn the engine OFF for the remainder of the procedure.** 3. Start the engine and idle. **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. 6. Deceleration to 0 km/h (0 mph). 7. Engine idling for 2 minutes or until the I/M System Status indicator updates to YES. Did the EVAP 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</u>**	Go to **Step 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			

4	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. This may take up to 2 hours. 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?	-	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**	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 I/M readiness diagnostics for the oxygen sensor/heated 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 more than 70°C (158°F).
- The engine is running in Closed Loop fuel control.
- The engine has been running for more than 13 minutes.
- The battery voltage is between 11-18 volts.
- The fuel level is more than 10 percent.
- The engine speed is between 1,000-3,500 RPM.
- The short term fuel trim (FT) is between -20 and +20 percent.

- The vehicle speed sensor (VSS) is between 32-121 km/h (20-75 mph).
- The throttle position (TP) sensor parameter is between 8-40 percent.
- The manifold absolute pressure (MAP) sensor parameter is between 10-104 kPa.

Diagnostic Aids

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 an 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	Value (s)	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 the engine to idle. **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:** 4. Acceleration at part throttle to 72-89 km/h (45-55 mph) with this speed maintained for 6 minutes. 5. Deceleration to 0 km/h (0 mph). 6. Engine idling for 2 minutes while the following criteria is maintained:	-		

	• Service brake is depressed • Automatic transmission in drive • Manual transmission in neutral with the clutch pedal depressed 7. 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 **Diagnostic Trouble Code (DTC) List**	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. This may take up to 2 hours. 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 **Diagnostic Trouble Code (DTC) List**	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 I/M readiness diagnostics for the heated oxygen sensor (HO2S) heater 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 more than 70°C (158°F).
- The battery voltage is between 10-17 volts.
- The fuel level is more than 10 percent.
- The engine run time is more than 60 seconds.

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 2 hours on some vehicles before a decision of pass or fail is made. If the test does not update to YES, it may have aborted due to the loss of enabling conditions.

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 an 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 **Inspection/Maintenance (I/M) System Check**
	IMPORTANT: **Whenever the ignition is turned ON, ignition positive voltage is supplied to the 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.**			

2	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. Set the vehicle parking brake. 4. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 5. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 6. Start the engine and allow the engine to idle for the specified time or until the I/M System Status indicator updates to YES. Did the HO2S Heater System Status update to YES?	2 minutes	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**	Go to **Step 4**
4	1. Refer to **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. This may take up to 2 hours. 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**	System OK

Engine Controls (Troubleshooting) - 3.5L (L66) - Vue

DIAGNOSTIC INFORMATION & PROCEDURES

SYMPTOMS - ENGINE CONTROLS

Important Preliminary Checks Before Starting

Perform the **Diagnostic System Check - Engine Controls** and verify that all of the following are true before using the Symptom tables:

- The powertrain control module (PCM) and the malfunction indicator lamp (MIL) are operating correctly.
- There are no DTCs stored.
- The scan tool data is within a normal operating range.
- Verify the customer concern and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Several of the symptom procedures call for a careful visual/physical check. DO NOT neglect to perform the visual/physical check. The visual/physical check is an important procedure that can lead to the correction of a concern without further diagnosis. The performance of the visual/physical check can save valuable time. The visual/physical check should include the following:

- Inspect all the PCM grounds for secure and clean connections that are in the proper location.
- Check all vacuum hoses for splits, kinks, and proper connections, as shown on the Vehicle Emission Control Information label. Check the vacuum hoses thoroughly for any type of leak or restriction.
- Inspect the air inlet ducts for collapsed or restricted sections.
- Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
- Inspect the wiring harness for the correct connections and for damage.

For more symptom base diagnostics refer to the following tables:

- **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**
- **Restricted Exhaust** in Engine Exhaust
- **Malfunction Indicator Lamp (MIL) Inoperative**
- **Malfunction Indicator Lamp (MIL) Always On**

INTERMITTENT CONDITIONS

Intermittent Conditions

Checks	Action
DEFINITION: The problem may or may not turn ON the MIL or store a DTC. There is a customer concern, but the symptom can not currently be duplicated, or the DTC diagnostic table indicates the fault not present at this time.	
Preliminary Checks	• Refer to Important Preliminary Checks in **Symptoms - Engine Controls** . • The fault must be present in order to be diagnosed correctly with a DTC table. If the fault that set the DTC is intermittent, then the use of DTC tables may result in replacement of good parts.
Electrical Connections or Wiring	Electrical connections and wiring cause most intermittent conditions. Determine which circuit is suspected of having an intermittent condition. This may be indicated by DTCs with a fault not present. Check the suspect circuit for the following conditions: • Any connectors that are poorly mated • Any terminals that are not fully seated in the connector • Any terminals that are not properly formed or damaged • A poor male to female connection-Checking for proper terminal retention requires the use of the **J-38125** Terminal Repair Kit. • Any poor terminal-to-wire connections-Checking for poor terminal-to-wire connections requires removing the wire/terminal from the connector body. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. • Any wires that are broken inside the insulation • A pierced or damaged insulation that allows water or 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 circuit. Refer to **Wiring Repairs** and to **Connector Repairs** in Wiring Systems for the proper procedures to use when making a circuit repair.
Road Test	The following tests should be performed with 2 people in order to ensure the safe operation of the vehicle. • Drive the vehicle while monitoring the suspect circuit with a scan tool or a DMM connected to the circuit. Look for an abnormal reading or voltage when the

	malfunction occurs. An abnormal reading on the scan tool or an abnormal voltage on the DMM display is an indication that there may be a malfunction in the circuit that was being monitored. • Certain DTCs must run before I/M system status can be determined. Any DTC that affects the status of an I/M system can be monitored indirectly on the scan tool under the I/M System Information selection. In order to determine which DTCs are associated with a particular I/M system test, refer to **Inspection/Maintenance (I/M) System DTC Table** . If an intermittent DTC is associated with a particular I/M system, monitoring the I/M system test can indicate whether the diagnostic for that DTC has run. When the I/M system test displays a YES status, indicating that the system diagnostic is complete, check for the applicable DTC in the Last Test Failed screen of the scan tool. If the DTC is not displayed, the diagnostic for that DTC has run and passed, indicating that no malfunction was present this time. All DTCs MUST BE CLEARED in order to view the Current Status of the I/M system tests. Do not forget that the I/M System Information tests only indicate that the test has run, not if the test passed or failed. The Last Test Failed screen must be checked for related DTCs in order to determine the outcome of the diagnostic test involved.
Scan Tool	The scan tool features that can be used to locate an intermittent conditions include the following: • The scan tool Snapshot feature-The scan tool Snapshot feature can be triggered to capture and store engine parameters when a malfunction occurs. This stored information can be reviewed and compared to the Typical Scan Tool Data Values or to data values taken from a similarly equipped known-good vehicle. • The Freeze Frame/Failure Records data feature-The Freeze Frame/Failure Records are stored when certain DTCs set. They typically include information to aid in reproducing the driving conditions that were present when a DTC is stored. In addition, the engine parameters are also stored. This stored information can be reviewed and compared to the typical **Scan Tool Data List** values or to data values taken from a similarly equipped known-good vehicle. The Freeze Frame/Failure Records data will be erased when DTC Information is cleared either with the scan tool or by disconnection of the control module power supply.
Intermittent malfunction indicator lamp (MIL)	The following conditions may cause intermittent MIL operation with no DTCs stored: • A defective relay, control module driven solenoid, or a switch that causes electrical system interference-Usually the symptom will occur when the faulty component is operating. • Any ignition control (IC) wires routed near the generator or near the secondary ignition system wires and components • An ignition system secondary voltage that is arcing and shorting to ground • Any poor ignition control circuit or ignition module grounds • Any faulty diodes in the generator or charging system circuits

	• The improper installation of add-on electrical devices-These can include the following:
	  ○ Alarm systems
	  ○ 2-way radios
	  ○ Lighting systems
	  ○ Electrical motors

Loss of DTC Memory	In order to check for proper DTC Memory function, perform the following procedure: 1. Observe the Conditions For Running The DTC for the intake air temperature (IAT) sensor circuit high voltage DTC. 2. Disconnect the IAT sensor connector. 3. Operate the vehicle within the Conditions for Running the DTC. 4. The MIL should illuminate upon completion of all the Conditions for Running the DTC. Two key cycles or drive trips may be required. 5. An IAT sensor circuit high voltage DTC should be stored in the PCM and remain in memory when the ignition is turned OFF. A failure to store a DTC or failure of the DTC to remain in memory may indicate a faulty PCM.

Additional Checks	• Check for faulty PCM grounds. Refer to **Engine Controls Schematics** .
	• Check for open diodes (A/C clutch, charging system, etc.) that may cause electrical interference.
	• The improper installation of add-on electrical devices-These can include the following:
	  ○ Alarm systems
	  ○ 2-way radios
	  ○ Lighting systems
	  ○ Electrical motors
	• If the intermittent fault is believed to involve a particular sensor or component, observe the sensor or component display on a scan tool while moving the connectors and the wiring harnesses related to the sensor or the component. A change in the scan tool display can indicate the location of the fault.

HARD START

Hard Start

Checks	Action
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary	• Refer to **Diagnostic System Check - Engine Controls** .

Checks	• Refer to **Symptoms - Engine Controls** . • Check that the driver is using the correct starting procedure.
Sensor Checks	• Check the engine coolant temperature (ECT) sensor using a scan tool to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5°C (9°F) more or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or in the sensor. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** . • Check the crankshaft position (CKP) sensor engine reference signal with a scan tool. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200-300 RPM while cranking. If erratic values, such as sudden spikes in the engine speed are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
Fuel System Checks	• Check the fuel pump relay for correct operation. Observe the fuel pump relay operation on a scan tool while cranking the engine. • Check the fuel pressure. Refer to **Fuel System Diagnosis** . • Check for water contamination in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . • Check the fuel pump check valve. A faulty fuel pump check valve will allow the fuel in the lines to drain back into the tank after stopping the engine. This condition is especially troublesome on hot soak restarts. In order to check for this condition perform the following steps: 1. Turn OFF the ignition. 2. Install the fuel pressure gage. Refer to **Fuel Pressure Gage Installation and Removal** . 3. Pressurize the fuel rail by turning the ignition key ON and OFF a few times. 4. Turn the ignition key ON and observe the fuel pressure. The fuel pressure has to remain more than 275 kPa (40 psi) for at least 5 minutes.
Ignition System Checks	• Check for the proper secondary voltage output with a J 26792 Spark Tester or equivalent. Refer to **Electronic Ignition (EI) System Diagnosis** . • Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** . • Check for bare or shorted ignition system wiring. • Check for loose ignition coil connections.
Additional Checks	• An incorrect TP learned value can cause a hard start condition and needs to be reset. Before resetting the TP learned value, inspect for excess deposits in the throttle body and clean as necessary. Refer to **Throttle Body Service** and **Scan Tool Output Controls** . • Check the Service Bulletins for any updates.

SURGES/CHUGGLES

Surges and/or Chuggles Symptom

Checks	Action
DEFINITION: The engine has a power variation under a steady throttle or cruise. There is a feeling as if the vehicle speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** . • Be sure the driver understands the A/C compressor operation. • Use a scan tool to make sure the reading of the vehicle speed sensor (VSS) matches the reading of the instrument panel speedometer. Transmission performance can be affected by incorrect VSS readings. If accuracy of the VSS is a concern, refer to **Speedometer and/or Odometer Inaccurate or Inoperative** in Instrument Panel, Gages, and Console.
Sensor Checks	• Test for correct operation of the engine coolant temperature (ECT) sensor. A fixed or inaccurate ECT sensor input can cause the engine to surge. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** . • Test for the correct operation of the manifold absolute pressure (MAP) sensor. A fixed or inaccurate MAP sensor input can cause the engine to surge. Observe the MAP sensor voltage parameter with a scan tool. Compare the MAP sensor voltage to that of another vehicle, with the ignition ON and the engine OFF.

Fuel System Checks	• Determine if a rich or lean system can cause the condition. Drive the vehicle at the speed of the concern. Monitoring the Fuel Trim may help identify the problem.
	  ○ Lean-The Long Term Fuel Trim will be more than 17 percent. Refer to **DTC P0171 or P0174** .
	  ○ Rich-The Long Term Fuel Trim will be more than -15 percent. Refer to **DTC P0172 or P0175** .
	• Test the fuel injectors. Perform the following procedures:
	  ○ The Fuel Injector Coil Test. Refer to **Fuel Injector Coil Test** .
	  ○ The Fuel Injector Balance Test-Refer to **Fuel Injector Balance Test with Tech 2** .
	• Test the fuel pressure while the condition exists. Refer to **Fuel System Diagnosis** .

Ignition System Checks	• Test for the correct secondary voltage output with a **J 26792** Spark Tester. • Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** .
Additional Checks	• Inspect the powertrain control module (PCM) grounds for being clean, tight, and in the proper locations. Refer to **Engine Controls Schematics** . • Inspect the positive crankcase ventilation (PCV) valve for correct operation and the correct part. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Test the generator for the correct output voltage. • Inspect the vacuum lines and hoses for leaks or incorrect routing. Refer to **Emission Hose Routing Diagram** .

	• Inspect for the correct operation and the correct shifting of the automatic transmission. Inspect for correct operation and engagement of the torque converter clutch (TCC). Refer to **Symptoms - Automatic Transmission** in Automatic Transmission - 5AT.

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Lack Of Power, Sluggishness, Or Sponginess

Checks	Action
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** . • Compare the customers vehicle with a similar unit in order to determine if the customer has an actual condition. • Remove the air filter element and check for dirt or restrictions. • Check the air inlet duct for any blockage or restrictions. • Check the transmission shift pattern and down-shift operation.
Sensor/System	Inspect the throttle actuator control (TAC) system for correct operation. Refer to **Throttle Actuator Control (TAC) System Description** .
Fuel System Checks	• Test for a restricted fuel filter or incorrect fuel pressure. • Test the fuel injectors. Perform the following procedures: o The Fuel Injector Coil Test-Refer to **Fuel Injector Coil Test** . o The Fuel Injector Balance Test-Refer to **Fuel Injector Balance Test with Tech 2** . • Test for contaminated fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
Ignition System Checks	• Test for the proper ignition voltage output with a J 26792 Spark Tester. • Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** . • Inspect the knock sensor (KS) and the sensor circuit shielding. A faulty knock sensor or signal interference could cause excessive retard of the ignition timing advance. Observe the spark parameter on a scan tool and compare with a known good vehicle.
Exhaust System Checks	• Test the exhaust system for a possible restriction. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect the exhaust system for damaged or collapsed pipes. Inspect the muffler for heat distress or a possible internal failure.
Engine Mechanical Check	• Check for any of the following engine mechanical problems: o A low compression

	○ An incorrect valve timing ○ An incorrect or worn camshaft • Refer to **Symptoms - Engine Mechanical** in Engine Mechanical-3.5L.
Additional Checks	• If the loss of power is above 4,200 RPM, inspect for the correct operation of the Rocker Arm Oil Control system. Refer to **DTC P2646** . • Check the powertrain control module (PCM) grounds for being clean, tight, and in the correct locations. Refer to **Engine Controls Schematics** . • Check the generator output voltage.

DETONATION/SPARK KNOCK

Detonation/Spark Knock

Checks	Action
DEFINITION: A mild to severe ping that is usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.	
Preliminary Checks	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** . • Road test the vehicle in order to determine the severity of the condition.
Cooling System Checks	• Check for any obvious overheating problems. Refer to **Engine Overheating** in Engine Cooling. • Check for a low engine coolant level. Refer to **Loss of Coolant** in Engine Cooling. • Check for a loose water pump belt. • Check for restricted air flow to the engine compartment. • Check for restricted coolant flow through the radiator. • Check for a faulty or incorrect thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling. • Check for the correct coolant solution. The solution should be a 50/50 mix of anti-freeze and water.
Sensor Check	Check for an engine coolant temperature (ECT) sensor that has a shifted value. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** .
Fuel System Checks	• Check to determine if a lean system causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the Fuel Trim will help identify the problem. If the system is lean, the Long Term Fuel Trim will be more than 20 percent. • Check the fuel pressure. Refer to **Fuel System Diagnosis** . • Check the fuel injectors. Perform the Fuel Injector Coil Test procedure and the Fuel Injector Balance Test procedure. Refer to **Fuel Injector Coil Test** and to **Fuel Injector Balance Test with Tech 2** . • Check for inferior quality fuel and the proper octane rating. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . Fill the fuel tank with a known high

	quality fuel that meets the vehicles minimum octane requirements. Road test the vehicle and re-evaluate the vehicle performance.
Ignition System Checks	• Check the spark plugs for the correct gap. Refer to **Ignition System Specifications** . • Inspect the spark plugs for excessive deposits that can glow and pre-ignite the air/fuel mixture. Refer to **Spark Plug Inspection** . • Check the spark plugs for the correct type and the correct heat range. Refer to **Ignition System Specifications** .
Engine Mechanical Checks	• Check for carbon buildup. Remove the carbon with a top engine cleaner product. Follow the manufacturer instructions on the container. • Check for excessive quantity oil entering the combustion chamber. Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • Check for incorrect basic engine parts such as the cam, the heads, the pistons, etc.
Additional Checks	• Check for a dirty air filter or a restriction in the air induction system. • Check for any Service Bulletins or updates.

HESITATION, SAG, STUMBLE

Hesitation, Sag, Stumble

Checks	Action
DEFINITION: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move, as from a stop sign. The condition may cause the engine to stall if severe enough.	
Preliminary Check	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** .

Fuel System Checks	• Check for a restricted fuel filter or incorrect fuel pressure. Refer to **Fuel System Diagnosis** .
	• Check the fuel injectors. Perform the following procedures:
	  • The Fuel Injector Coil Test Procedure-Refer to **Fuel Injector Coil Test** .
	  • The Fuel Injector Balance Test Procedure-Refer to **Fuel Injector Balance Test with Tech 2** .
	• Check for water contamination of the fuel.
	• Check the evaporative emission (EVAP) control system for a saturated EVAP canister.

Ignition System Checks	Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** .
Additional Checks	• Check the Service Bulletins for any updates. • Check the generator output voltage.

CUTS OUT, MISSES

Cuts Out, Misses Symptom

Checks	Action
DEFINITION: A steady pulsation or jerking that follows engine speed, usually more pronounced as the engine load increases. The exhaust has a steady spitting sound at idle, low speed or on hard acceleration.	
Preliminary Checks	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** .
Sensor Checks	Check the engine coolant temperature (ECT) sensor using a scan tool in order to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5°C (9°F) more or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or in the sensor. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** .
Fuel System Checks	• Check for a restricted fuel filter or an incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Check the fuel injectors. Perform the Fuel Injector Coil Test procedure and the Fuel Injector Balance Test procedure. Refer to **Fuel Injector Coil Test** and **Fuel Injector Balance Test with Tech 2** . • Perform the engine cylinder balance test: 1. Start the engine. 2. Use the scan tool in order to turn OFF each fuel injector one at a time. Refer to **Scan Tool Output Controls** . 3. Observe the engine speed for each cylinder while testing. 4. If there is an equal RPM drop on all cylinders (equal to within 50 RPM), the output from each cylinder is satisfactory. • Check for water contamination of the fuel.
Ignition System Checks	Test the ignition system for the correct operation. Verify that each coil has good crisp, blue spark. Diagnose and repair any coil with a weak spark output. Refer to **Electronic Ignition (EI) System Diagnosis** .
Engine Mechanical Checks	• Check for any of the following engine mechanical problems: ○ Any faulty hydraulic lifter assemblies ○ Any broken or weak valve springs ○ An incorrect valve timing ○ An incorrect or worn camshaft • Check the intake and exhaust manifold passages for casting flash. • Refer to the **Symptoms - Engine Mechanical** in Engine Mechanical-3.5L.
Additional Checks	• An engine miss condition can be caused by electromagnetic interference (EMI) on the reference circuit. EMI can usually be detected by monitoring the engine speed with a scan tool. A sudden increase in speed with little change in the actual engine

	speed change indicates EMI is present. • Verify the powertrain control module (PCM) grounds are clean, tight, and in the correct locations. Refer to **Engine Controls Schematics** .

POOR FUEL ECONOMY

Poor Fuel Economy

Checks	Action
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary Checks	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** . • Check the air cleaner element for dirt or restrictions. • Visually and physically check the vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Control Information label. • Check the owners driving habits for any of the following: o The A/C system defroster mode is ON all the time. o The tires are improperly inflated. o Heavy loads are frequently being carried. o Heavy acceleration and high speeds are common. o Frequent short trips o Prolonged periods of idling o Driving on unpaved or rough roads • Suggest that the owner refill the fuel tank and recheck the fuel economy.
Fuel System Checks	• Check the type, quality, and alcohol content of the fuel. Oxygenated fuels have lower energy and may deliver reduced fuel economy. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . • Check for the correct fuel pressure. Refer to **Fuel System Diagnosis** .
Ignition System Checks	• Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** . • Check the ignition coil boots for cracking, chafing, and loose connections. • Observe the Spark parameter on the scan tool at idle, while operating the rear defogger, the A/C system, or the headlights. • Check the knock sensor (KS) and the sensor circuit shielding. A faulty knock sensor or signal interference could cause excessive retard of the ignition timing advance. Observe the Spark parameter on a scan tool and compare with a known good vehicle.
Cooling System	• Check for the correct engine coolant level. • Check the engine thermostat for always being open or for the wrong heat range.

Checks	Refer to **Thermostat Diagnosis** in Engine Cooling.
Additional Checks	• Check the transmission shift pattern and the torque converter clutch (TCC) operation in vehicles equipped with an automatic transmission. Refer to Symptoms - Automatic Transmission in Automatic Transmission. • Check for dragging brakes. Refer to **Brakes Drag** in Hydraulic Brakes. • Check for uneven or premature tire wear. A suspension misalignment can cause reduced fuel economy. Refer to **Measuring Wheel Alignment** in Wheel Alignment. • Verify that the tires and wheels are similar to OEM. Wide performance tires create more drag and taller tires can cause odometer discrepancies. • Check for the speedometer for proper calibration. Refer to **Speedometer and/or Odometer Inaccurate or Inoperative** in Instrument Panel, Gages, and Console. • Check for a green engine. Fuel economy may not be near expected levels until the engine has had 5 000-8 000 km (3,000-5,000 miles) to break in. • Check for add-on equipment like luggage racks and carriers. Wind resistance can lower fuel economy. • Check the Service Bulletins for any updates or information.

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Concern	Causes
DEFINITION: Difficulty when refueling the vehicle.	
Difficult to fill	• The fuel filler pipe check valve is stuck closed. • The fill limiter vent valve (FLVV) is stuck closed. • Any restricted vapor lines or hoses • The EVAP canister is restricted. • A fuel with high reid vapor pressure characteristics. • A high fuel temperature • The fuel filler hose/pipe is pinched, kinked, or blocked.
Over fill	• The pressure relief valve in the fill limiter vent valve (FLVV) is stuck open. • The pressure relief valve in the FLVV is leaking. • The FLVV is stuck open. • The FLVV is leaking.
Pre-mature shut-off of the fuel dispensing nozzle	• The fill limiter vent valve (FLVV) is stuck closed. • Any restricted vapor lines or hoses • The EVAP canister is restricted. • A fuel with high reid vapor pressure characteristics

	• A high fuel temperature
Fuel spitback	• The fuel filler pipe check valve is stuck open. • The filler pipe check valve is stuck closed. • The filler pipe check valve is leaking. • A fuel with high reid vapor pressure characteristics. • A high fuel temperature
Liquid fuel in the EVAP canister	• The fill limiter vent valve is stuck open. • The fill limiter vent valve is leaking.
Liquid fuel leak	• The pressure relief valve in the fill limiter vent valve (FLVV) is stuck open. • The pressure relief valve in the FLVV is leaking. • The fuel filler hose is loose or torn. • The FLVV is stuck open.
Fuel odor	• The pressure relief valve in the fuel limiter vent valve (FLVV) is stuck open. • The pressure relief valve in the FLVV is leaking. • The EVAP canister is saturated with fuel.

ROUGH, UNSTABLE, OR INCORRECT IDLE AND STALLING

Rough, Unstable, or Incorrect Idle, Stalling

Checks	Action
DEFINITION: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine. The engine idles at an incorrect speed.	
Preliminary Check	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** .
Sensor Checks	• Inspect the engine coolant temperature (ECT) sensor. A fixed or inaccurate ECT sensor reading can cause the engine idle to surge or race. Using the scan tool, compare the ECT with the ambient air temperature on a cold engine. If the engine coolant is 5°C (9°F) more than or 5°C (9°F) less than the ambient air temperature, inspect the resistance of the coolant sensor. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** . If the ECT is significantly less than the ambient air temperature, inspect the coolant sensor electrical circuit for high resistance. • Inspect the throttle actuator control (TAC) system for correct operation.
Fuel System Checks	• Inspect the operation of the fuel system for rich or lean condition. Operate the vehicle under the conditions that caused the concern. Monitor the Fuel Trim parameter on a scan tool in order to identify the problem. o Lean-The Long Term Fuel Trim will be more than 17 percent. Refer to

	Diagnostic Aids in **DTC P0171 or P0174** . ○ Rich-The Long Term Fuel Trim will be more than -15 percent. Refer to Diagnostic Aids in **DTC P0172 or P0175** • Test the fuel pressure while the condition exists. Refer to **Fuel System Diagnosis** . • Inspect the evaporative emission (EVAP) control system for a saturated EVAP canister. • Test the fuel injectors for leaking. Refer to **Fuel Injector Balance Test with Tech 2** .
Ignition System Checks	• Test for the proper secondary voltage output with a J 26792 Spark Tester. • Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** . • Inspect the ignition coil boots for damage.
Engine Mechanical Check	• Inspect for the following engine mechanical conditions: ○ Any faulty hydraulic lifter assemblies ○ Any broken or weak valve springs ○ A low compression ○ An incorrect valve timing ○ Any sticking or leaking valves ○ An incorrect or worn camshaft • Refer to the **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L.
Additional Checks	• Inspect for vacuum leaks. Vacuum leaks can cause a higher than normal idle speed. • Verify the PCM grounds are clean, tight, and in the proper locations. Refer to **Engine Controls Schematics** . • An incorrect TP learned value can cause a rough or incorrect idle speed concern and needs to be reset. Before resetting the TP learned value, inspect for excess deposits in the throttle body and clean as necessary. Refer to **Throttle Body Service** and **Scan Tool Output Controls** . • Check the scan tool to determine if the PCM is receiving an A/C signal. The idle speed should be increased with the A/C ON. • Inspect the battery cables and the ground straps. They should be clean and secure. • Inspect the A/C refrigerant pressure for being too high or for a faulty high pressure switch. Refer to **Air Conditioning (A/C) System Performance Test (L61)Air Conditioning (A/C) System Performance Test (L66)** in Heating, Ventilation, and Air Conditioning. • The engine will run rough and the engine can stall if the rocker arm oil control solenoid. stuck ON. Refer to **DTC P2647** . • Inspect the positive crankcase ventilation (PCV) valve for correct operation and the correct part. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 3.5L. • Inspect for the correct operation of the exhaust gas recirculation (EGR) valve. An

	EGR valve that leaks can cause a rough idle condition. • Verify that the PCM is increasing the idle speed when the P/S system pressure is increased on turns. • Inspect for broken or worn motor and transmission mounts.

DIESELING, RUN-ON

Dieseling, Run-On

Checks	Action
DEFINITION: Engine continues to run when turning the ignition OFF, but runs very roughly. If the engine runs smoothly, check the ignition switch and adjustment.	
Preliminary Check	Refer to **Diagnostic System Check - Engine Controls** . Refer to **Symptoms - Engine Controls** .
Fuel System Checks	• Check the evaporative emission (EVAP) control system for proper operation or a saturated EVAP canister. • Check the fuel injectors for leaking. Refer to **Fuel Injector Balance Test with Tech 2** .

BACKFIRE

Backfire

Checks	Action
DEFINITION: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary Check	• Refer to **Diagnostic System Check - Engine Controls** . • Refer to **Symptoms - Engine Controls** .
Ignition System Checks	• Check for the proper ignition coil output voltage with a J 26792 Spark Tester or equivalent. • Inspect the spark plugs for correct operation and good ignition system performance. Refer to **Spark Plug Inspection** . • Inspect the ignition coil boots for damage.
Engine Mechanical Checks	• Check for any of the following engine mechanical problems: o Any broken or weak valve springs o A low compression o Any sticking or leaking valves o An incorrect valve timing o An incorrect or worn camshaft Refer to **Symptoms - Engine Mechanical** in Engine Mechanical-3.5L.

	• Check the intake and the exhaust system for casting flash or other restrictions.

MALFUNCTION INDICATOR LAMP (MIL) INOPERATIVE

Circuit Description

There should always be a steady malfunction indicator lamp (MIL) when the ignition switch is in the ON position and the engine is not running. System voltage is applied to the indicator bulb and the instrument panel cluster (IPC) provides a path to ground. Once the engine starts, the IPC turns OFF the MIL. When an engine control system malfunction occurs, the PCM sends a message over the controller area network (CAN) to the body control module (BCM) requesting the MIL. The BCM then sends a message to the IPC over class 2 requesting MIL illumination.

Test Description

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

2: If other instrument panel cluster (IPC) functions are not working correctly check for an open fuse or for a lack of power and ground to the IPC.

Malfunction Indicator Lamp (MIL) Inoperative

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the instrument panel cluster (IPC) assembly operation. Do all other functions of the IPC function normally?	Go to **Step 3**	Go to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gages and Console
3	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages and Console. Did you complete the replacement?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

MALFUNCTION INDICATOR LAMP (MIL) ALWAYS ON

Circuit Description

There should always be a steady malfunction indicator lamp (MIL) when the ignition switch is in the ON position and the engine is not running. System voltage is applied to the indicator bulb and the instrument panel cluster (IPC) provides a path to ground. Once the engine starts, the IPC turns OFF the MIL. When an engine

control system malfunction occurs, the PCM sends a message over the controller area network (CAN) to the body control module (BCM) requesting the MIL. The BCM then sends a message to the IPC over class 2 requesting MIL illumination.

Diagnostic Aids

If the MIL is ON at all times, and there are no powertrain DTCs set, there is a condition with the CAN or the class 2 circuits.

Malfunction Indicator Lamp (MIL) Always On

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gages and Console	Go to **Diagnostic System Check - Engine Controls**

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. In order for the engine to start and run, the correct amount of good quality fuel must be properly delivered to each cylinder. The timing of the valve train operation in relation to piston position is also critical, as is mechanical compression of the air/fuel mixture.

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

- The battery is completely charged. Refer to **Battery Inspection/Test (Side Terminal Battery)** or **Battery Inspection/Test (Top Post Terminal Battery)** 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.

Diagnostic Aids

Inspect for any of the following conditions:

- Insufficient fuel can cause a no start condition. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid, can cause a no start condition. Refer to **Fuel Injector Coil Test** and **Fuel Injector Balance Test with Tech 2** .
- There may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the fuel injectors and the injector circuit are OK, and fuel spray

is detected, the fuel injector ON time may be inadequate. If the PCM receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.

- Check the crankshaft position (CKP) sensor engine reference signal with a scan tool. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200-300 RPM while cranking. If erratic values, such as sudden spikes in the engine speed are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
- Inspect the engine for good secure electrical grounds. Refer to **Engine Controls Schematics** .
- If the engine almost starts and then stalls, check for an open in the ground circuits of the CKP sensor and the camshaft position (CMP) sensor.
- Water or foreign material in the fuel can cause a no start or engine will not stay running condition. During freezing weather water can freeze inside the fuel system. The engine may start after 30 minutes in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.
- A vehicle that starts and runs after being brought to the repair shop for a no start complaint, may have an ignition system that is susceptible to moisture. Spray water on the ignition system components and the wiring in order to check for an engine starting or will not stay running concern.

An intermittent malfunction may be caused by fault in any of the critical information or component electrical circuits. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

Test Description

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

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: The listed DTCs can cause a no start. If a DTC is set, diagnose the DTC before using this diagnostic procedure.

3: A theft deterrent system condition, may cause a no start. If a theft deterrent DTC is set, diagnose the DTC before using this diagnostic procedure.

4: If a crankshaft position (CKP) sensor is disconnected, a no start condition occurs without setting a DTC. If there is a condition with both CKP sensor circuits, a no start condition occurs without setting a DTC.

7: This step verifies if there is any fuel pressure. If there is no fuel pressure the fuel system diagnosis must be performed.

9: This step verifies if the engine will start and run. The repair that may have led to this step may only have been a secondary cause of the no start condition, such as fouled spark plugs. The diagnostics in this table may need to be performed a second time in order to discover the root cause of the no start condition.

Engine Cranks but Does Not Run

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Crank the engine over for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the DTC information with a scan tool. Does the scan tool display DTC P0118, P0201, P0202, P0203, P0204, P0205, P0206, P0602, P1621, P1630, or P1631?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Observe the theft deterrent DTC information with a scan tool. Does the scan tool display any theft deterrent DTCs?	-	Go to **Diagnostic Trouble Code (DTC) List** in Theft Deterrent	Go to **Step 4**
4	Crank the engine over for 10 seconds, while you observe the engine speed parameter with a scan tool. Is engine speed displayed on the scan tool?	-	Go to **Step 5**	Go to **Electronic Ignition (EI) System Diagnosis**
5	1. Remove an ignition coil from bank 1 of the engine. Refer to **Ignition Coil(s) Replacement - Bank 1** . 2. Connect the ignition coil electrical connector. 3. Install the **J 26792** Spark Tester to the ignition coil boot. 4. Observe for a crisp, blue spark while cranking the engine. 5. Remove an ignition coil from bank 2 of the engine. Refer to **Ignition Coil(s) Replacement - Bank 2** . 6. Repeat steps 2 thru 4 for the bank 2 ignition coil. Was there a crisp blue spark for both ignition coils tested?	-	Go to **Step 6**	Go to **Electronic Ignition (EI) System Diagnosis**

6	Command the fuel pump ON, with a scan tool. Refer to **Scan Tool Output Controls** . Does the fuel pump turn ON?	-	Go to **Step 7**	Go to **Fuel Pump Electrical Circuit Diagnosis**
7	1. Turn OFF the ignition. 2. Install the **SA9127E** Fuel Pressure Gage. Refer to **Fuel Pressure Gage Installation and Removal** . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump ON, with a scan tool. Is the fuel pressure within the specified range while the fuel pump is operating?	330-382 kPa (48-56 psi)	Go to **Step 8**	Go to **Fuel System Diagnosis**

8	Inspect for the following conditions:
	• Collapsed air intake duct to the throttle body.
	• Restricted air filter element.
	• Spark plugs for being gas or coolant fouled. If the spark plugs are fouled, determine what caused the condition, refer to the following procedures:
	  ○ **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66).
	  ○ **Spark Plug Inspection**
	  ○ **Spark Plug Replacement**
	• Test for a restricted exhaust system. Refer to **Restricted Exhaust** in Engine Exhaust.
	• Test for water, alcohol, or other fuel contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
	• Engine mechanical condition, for example worn timing chain and gears, low compression. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66).
	• Test for an engine coolant temperature that is not close to the actual engine temperature. Refer to **DTC P0116** .
	
	Did you complete the action?
		-	Go to **Step 9**	-

9	1. With a scan tool, clear the DTCs. 2. Attempt to start the engine. Does the engine start and continue to operate?	-	Go to **Step 10**	Go to **Step 2**
10	1. Idle the engine. 2. Allow the engine to reach operating temperature. 3. Observe the DTC information with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

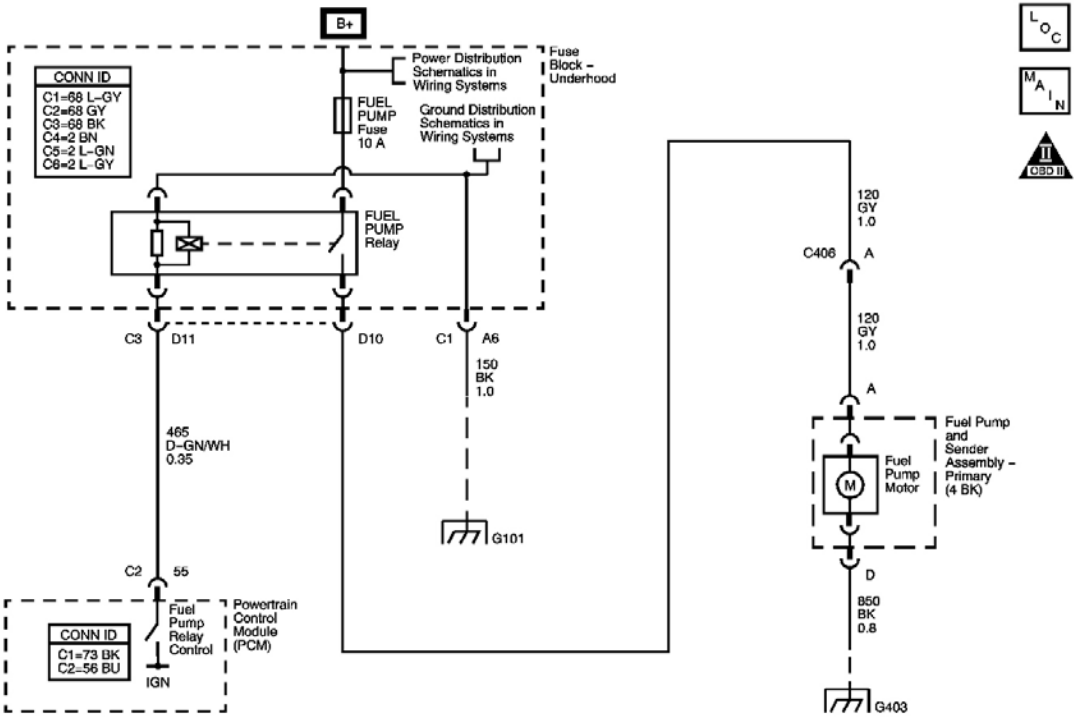

Fig. 1: Fuel Pump Electrical Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

When the ignition switch is turned ON, the powertrain control module (PCM) energizes the fuel pump relay which applies power to the in-tank fuel pump. The fuel pump relay will remain on as long as the engine is running or cranking and the PCM is receiving crankshaft position (CKP) sensor reference pulses. If no CKP

sensor reference pulses are present, the PCM de-energizes the fuel pump relay within 2 seconds after the ignition is turned ON or the engine is stopped.

Test Description

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

3: Command both the ON and OFF states. Repeat the commands as necessary. This can be determined by listening for an audible hiss from the fuel pump when the fuel pump relay is commanded ON or a vibration in the fuel feed line.

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

6: This step determines if the fuel pump relay is stuck closed.

8: This step tests for a grounded voltage supply circuit. The fuel pump fuse supplies power to fuel pump. Disconnecting the fuel pump in-line harness connector isolates the fuel pump voltage supply circuit.

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

11: This step verifies that the fuel pump fuse is providing voltage to the fuel pump relay.

12: This step tests for an open circuit or a short to ground causing an open Maxifuse.

13: This step bypasses the fuel pump relay in order to activate the fuel pump.

14: 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.

19: 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: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0628 or P0629 present?	Go to **DTC P0628** or **DTC P0629**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool. Refer to **Scan Tool Output Controls** . Does the fuel pump turn ON and OFF?	Go to **Intermittent Conditions**	Go to **Step 4**
	IMPORTANT: **An audible click should be heard.**		

4	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 5**	Go to **Step 10**
5	Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	Go to **Step 6**	Go to **Step 7**
6	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 21**	Go to **Step 25**
7	Is the fuel pump fuse open?	Go to **Step 8**	Go to **Step 11**
8	1. Disconnect the fuel pump harness in-line connector located near the fuel tank. 2. Test the supply voltage circuit of the fuel pump for a grounded circuit. Refer to **Circuit Testing** and **Connector Repairs** in Wiring Systems. 3. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 9**
9	1. Lower the fuel tank. Refer to **Fuel Tank Replacement** . 2. Test or inspect the fuel tank electrical harness for the following conditions: • Damage to the harness • A grounded fuel pump voltage supply circuit- Refer to **Circuit Testing** and **Connector Repairs** in Wiring Systems. 3. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 18**
10	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the fuel pump relay control circuit with a test lamp connected to a ground. 5. Command the fuel pump ON and OFF with a scan tool. Did the test lamp illuminate?	Go to **Step 19**	Go to **Step 20**
	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF.		

11	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 13**	Go to **Step 12**
12	1. Turn OFF the ignition. 2. Disconnect the fuel pump fuse. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive side of the fuel pump fuse, with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to **Step 22**	Go to **Step 23**
13	Connect a 10-amp fused jumper wire between the battery positive voltage circuit and the fuel pump supply circuit in the fuel pump relay cavity. Does the fuel pump operate?	Go to **Step 19**	Go to **Step 14**
14	1. Disconnect the fuel pump harness in-line connector located near the fuel tank. 2. Test the supply voltage circuit of the fuel pump for an open or for high resistance between the fuel pump relay and the in-line connector. Refer to **Circuit Testing** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 15**
15	**IMPORTANT:** **Inspect the fuel pump 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 for high resistance between the body pass through connector and the ground. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 27**	Go to **Step 16**
16	Inspect for poor connections at the fuel pump in-line connector to the body pass through connector. Refer to **Circuit Testing** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 17**
17	1. Lower the fuel tank. Refer to **Fuel Tank Replacement** . 2. Test or inspect the fuel tank electrical harness for the following conditions: • Damage to the harness • A short to ground		

	• An open circuit-Refer to **Circuit Testing** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 24**
18	1. Connect all disconnected components. 2. Install a new fuel pump fuse. 3. Command the fuel pump ON with a scan tool. Is the fuel pump fuse open?	Go to **Step 24**	Go to **Intermittent Conditions**
19	Inspect for poor connections at the fuel pump relay.Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 25**
20	Inspect for poor connections at the harness of the engine control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 26**
21	Repair the supply voltage circuit of the fuel pump for a short to voltage. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 27**	-
22	Repair the battery positive voltage circuit of the fuel pump relay for an open. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 27**	-
23	Repair the battery positive voltage circuit of the fuel pump fuse for an open or a short to ground. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 27**	-
24	**IMPORTANT:** **Inspect for poor connections at the fuel pump, within the fuel tank, before replacing the fuel pump.** 1. Replace the fuel tank module. Refer to **Fuel Tank Replacement** . 2. Replace the fuel pump fuse if necessary. Did you complete the replacement?	Go to **Step 27**	-
25	Replace the fuel pump relay. Refer to **Relay Replacement (Within an Electrical Center)Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 27**	-
	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** .		

26	2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 27**	-
27	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

FUEL SYSTEM DIAGNOSIS

System Description

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

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

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

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

Test Description

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

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step determines whether the fuel pump can provide fuel within the correct regulated pressure range.

4: This step tests that the fuel system can maintain fuel pressure with the pump Off. A fuel pressure drop of more than 55 kPa (8 psi) within the specified time indicates a leak in the fuel system.

6: This step determines whether the loss in fuel pressure is on the fuel tank side of the system, or the fuel rail side.

7: This step tests the operation of the fuel pressure regulator. If the fuel pressure exceeds the specified value, the fuel pressure regulator is faulty.

8: This step tests for a restriction in the fuel system.

Fuel System Diagnosis

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Inspect the fuel system for damage or external leaks before proceeding with this diagnostic.** 1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON with a scan tool. Refer to **Scan Tool Output Controls** . Does the fuel pump operate?	-	Go to **Step 3**	Go to **Fuel Pump Electrical Circuit Diagnosis**
3	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the **SA9127E** Gage Bar Set with the Fuel Pressure Adapter and the Drain Hose. Refer to **Fuel Pressure Gage Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **DO NOT start the engine.** 5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage with the fuel pump commanded ON. Is the fuel pressure within the specified range?	330-382 kPa (48-56 psi)	Go to **Step 4**	Go to **Step 7**
	IMPORTANT: **The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops**			

4	**operating, the fuel pressure should stabilize and remain constant.** Monitor the fuel pressure gage for 5 minutes.Does the fuel pressure decrease by more than the specified value?	55 kPa (8 psi)	Go to **Step 6**	Go to **Step 5**
5	1. Operate the vehicle within the conditions to reproduce the original symptoms. 2. Monitor the HO2S and the Fuel Trim parameters with a scan tool. Do the scan tool parameters indicate a lean condition?	-	Go to **Step 8**	Go to **Symptoms - Engine Controls**
6	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Remove the fuel pressure gage from the fuel pressure test connection. 4. Disconnect the chassis fuel hose from the engine compartment fuel pipe. 5. Connect the fuel feed hose to the inlet side of **SA9127E-7** Fuel Pressure/Flow Adapter using the **J 43937** 3/8 inch Male Fuel Pressure Adapter Line. 6. Connect the return hose from the **SA9127E-7** to the outlet side of **SA9127E-7** . 7. Place the other end of the return hose into the fuel filler pipe. 8. Connect the fuel pressure gage to the **SA9127E-7** . 9. Close the valve on the **SA9127E-7** . 10. Turn ON the ignition, with the engine OFF. 11. Command the fuel pump relay ON for a minimum of 10 seconds with a scan tool. 12. Record the fuel pressure. 13. Command the fuel pump relay OFF. 14. Monitor the fuel pressure gage for 5 minutes. Does the fuel pressure decrease by more than the specified value?	55 kPa (8 psi)	Go to **Step 11**	Go to **Step 9**
7	Is the fuel pressure more than the specified value?	382 kPa (56 psi)	Go to **Step 11**	Go to **Step 8**
	1. Turn OFF the ignition.			

8	2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Remove the fuel pressure gage from the fuel pressure test connection. 4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 5. Disconnect the chassis fuel feed pipe at the fuel tank pipe. 6. Connect the inlet side of **SA9127E-7** to the fuel tank pipe using the **J 43937** 3/8 inch Female Fuel Pressure Adapter Line. 7. Place the return hose from the **SA9127E-7** into the fuel filler pipe. 8. Connect the fuel pressure gage to the **SA9127E-7** . 9. Open the valve on the **SA9127E-7** . 10. Turn ON the ignition, with the engine OFF. 11. Command the fuel pump relay ON for a minimum of 10 seconds with a scan tool. Is the fuel pressure more than the specified value?	356 kPa (52 psi)	Go to **Step 10**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Open the valve on the **SA9127E-7** . 3. Remove the **SA9127E-7** . 4. Connect the chassis fuel hose to the engine compartment fuel pipe. 5. Raise the fuel rail, with the fuel line connected. 6. Turn ON the ignition, with the engine OFF. 7. Command the fuel pump relay ON with a scan tool. 8. Locate and replace the leaking fuel injector. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	1. Inspect for the following conditions: • A blockage or restriction in the fuel feed line • A damaged fuel feed line • A blockage or restriction in the fuel rail inlet	-		

	2. Repair the condition as necessary. Did you complete the repair?		Go to **Step 12**	-
11	Replace the primary fuel tank module. Refer to **Fuel Tank Module Replacement - Primary** . Did you complete the replacement?	-	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 3**

FUEL INJECTOR COIL TEST

Circuit Description

The powertrain control module (PCM) enables the appropriate fuel injector on the intake stroke for each cylinder. 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. A fuel injector coil winding resistance that is too high, or too 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 Tech 2** or **Fuel Injector Balance Test with Special Tool** .

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.

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

Fuel Injector Coil Test

Step	Action	Values	Yes	No

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
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 the DMM. Refer to **Testing for Continuity** in Wiring Systems. Do any of the fuel injectors display a resistance outside the specified range?	10-13 ohm	Go to **Step 6**	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 the DMM. Refer to **Testing for Continuity** in Wiring Systems 3. Record each fuel injector value. 4. Subtract the lowest resistance value from the highest resistance value. Is the difference equal to, or less than, the specified value?	3 ohm	Go to Diagnostic Aids	Go to **Step 5**
5	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 **Fuel Injector Replacement** .	-		

	Did you complete the replacement?		Go to **Step 7**	-
6	Replace the fuel injector or fuel injectors that are out of the specified range. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
7	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

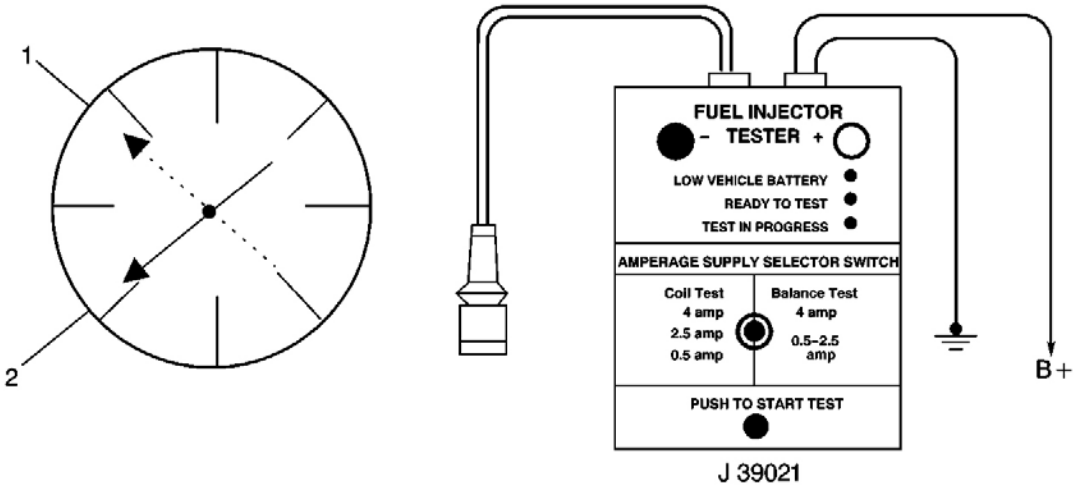

Fig. 2: Fuel Injector Balance Test & Special Tool
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	First Reading
2	Second Reading

Injector Balance Test Example

Cylinder	1	2	3	4	5	6
1st Reading	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)
2nd Reading	245 kPa (36 psi)	200 kPa (30 psi)	245 kPa (36 psi)	240 kPa (35 psi)	245 kPa (36 psi)	255 kPa (37 psi)
Amount of Drop	120 kPa (17 psi)	165 kPa (23 psi)	120 kPa (17 psi)	125 kPa (18 psi)	120 kPa (17 psi)	110 kPa (16 psi)
Average Range: 117-137 kPa (16.5-19.5	Injector	Faulty injector - too much fuel	Injector	Injector	Injector	Faulty injector - too little fuel

psi)	OK	drop	OK	OK	OK	drop

Test Description

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

3: The engine coolant temperature must be less than the operating temperature in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

4: The engine coolant temperature must be less than the operating temperature in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

5: This step checks that the fuel pressure is within the specified operating range.

6: This step checks for a steady fuel pressure reading. A steady fuel pressure reading indicates that the fuel system is operating properly.

7: The fuel injectors are flowing properly if the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading. Refer to the examples in the preceding table.

Fuel Injector Balance Test with Special Tool

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	**Go to Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Was the Fuel Injector Coil Test performed?	-	**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).** Is the engine coolant temperature (ECT) more than the specified value?	94°C (201°F)	**Go to Step 4**	**Go to Step 5**
4	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** Allow the engine to cool to less than the specified value.Is the engine coolant temperature less than the specified value?	94°C (201°F)	**Go to Step 5**	-
	CAUTION: **Refer to Fuel Gage Leak Caution in Cautions and Notices.**			

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.** 1. Install the **SA9127E** Fuel Pressure Gage. Refer to **Fuel Pressure Gage Installation and Removal** . **IMPORTANT:** • **The fuel pump relay may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.** • **DO NOT start the engine.** 2. Command the fuel pump relay ON with the scan tool or cycle the ignition switch ON and then OFF. Refer to **Scan Tool Output Controls** . 3. Observe the reading on the fuel pressure gage. Is the fuel pressure within the specified range?	330-382 kPa (48-56 psi)	**Go to Step 6**	Go to **Fuel System Diagnosis**
6	Turn OFF the fuel pump. Does the fuel pressure reading remain constant?	-	**Go to Step 7**	Go to **Fuel System Diagnosis**
	1. Disconnect the fuel injector electrical connectors. 2. Connect the **J 39021** Fuel Injector Tester power leads to B+ and ground. 3. Set the amperage supply selector switch on the fuel injector tester to the Balance Test 0.5-2.5 amp position. 4. Connect the refer to **J 39021** to a fuel injector. 5. Turn the ignition switch ON and then OFF, in order to energize the fuel pump. 6. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. This is the 1st pressure reading. 7. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester. **IMPORTANT:** **Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel**			

7	**pressure may rise after the fuel injector stops pulsing. DO NOT record the higher fuel pressure value.** 8. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure gage needle has stopped moving. This is the 2nd pressure reading. 9. Repeat Step 4 through Step 8 for each fuel injector. 10. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 11. Obtain a pressure drop value for each fuel injector. 12. Add all of the individual pressure drop values. This is the total pressure drop. 13. 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 higher or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	**Go to Step 8**	Go to **Symptoms - Engine Controls**
8	**NOTE:** **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** Re-test any fuel injector that does not meet the specification. Follow the procedures in Step 7.Does any fuel injector still have a pressure drop value that is higher or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	**Go to Step 9**	Go to **Symptoms - Engine Controls**
9	Replace any faulty fuel injectors. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	-	**Go to Step 10**	-
10	1. Start the engine. 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Does an engine performance concern still exist?	-	Go to **Symptoms - Engine Controls**	System OK

FUEL INJECTOR BALANCE TEST WITH TECH 2

System Description

The scan tool is first used to energize the fuel pump relay. The scan tool 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.

Injector Balance Test Example

Cylinder	1	2	3	4	5	6
1st Reading	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)	365 kPa (53 psi)
2nd Reading	245 kPa (36 psi)	200 kPa (30 psi)	245 kPa (36 psi)	240 kPa (35 psi)	245 kPa (36 psi)	255 kPa (37 psi)
Amount of Drop	120 kPa (17 psi)	165 kPa (23 psi)	120 kPa (17 psi)	125 kPa (18 psi)	120 kPa (17 psi)	110 kPa (16 psi)
Average Range: 117-137 kPa (16.5-19.5 psi)	Injector OK	Faulty injector - too much fuel drop	Injector OK	Injector OK	Injector OK	Faulty injector - too little fuel drop

Test Description

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

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

4: The engine coolant temperature must be less than the operating temperature in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

5: This step checks that the fuel pressure is within the specified operating range of this fuel system.

6: This step checks for a steady fuel pressure reading. A steady fuel pressure reading indicates that the fuel system is operating properly.

7: The fuel injectors are flowing properly if the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading. Refer to the examples in the preceding table.

Fuel Injector Balance Test with Tech 2

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Did you perform the Fuel Injector Coil Test?	-	Go to **Step 3**	Go to **Fuel Injector Coil Test**
	IMPORTANT: **DO NOT perform this test if the engine coolant**			

	temperature (ECT) is above 94°C (201°F).			
3	Observe the ECT Sensor parameter with a scan tool.Is the ECT Sensor parameter less than the specified value?	94°C (201°F)	Go to **Step 5**	Go to **Step 4**
4	Allow the engine to cool to less than the specified value. Is the engine coolant temperature less than the specified value?	94°C (201°F)	Go to **Step 5**	-
5	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the **SA9127E** fuel pressure gage. Refer to **Fuel Pressure Gage Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** • **The fuel pump relay may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.** • **DO NOT start the engine.** 5. Command the fuel pump relay ON with the scan tool. Refer to **Scan Tool Output Controls** . 6. Observe the fuel pressure gage, with the fuel pump operating. Is the fuel pressure within the specified value?	330-382 kPa (48-56 psi)	Go to **Step 6**	Go to **Fuel System Diagnosis**
6	Monitor the fuel pressure gage for 1 minute. Does the fuel pressure decrease by more than the specified value?	34 kPa (5 psi)	Go to **Fuel System Diagnosis**	Go to **Step 7**
	NOTE: **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** 1. With a scan tool, select the Fuel Injector Balance Test function, within the Special Functions menu.			

7	2. Select an injector to be tested. 3. Press Enter. This will prime the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. 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. Refer to **Scan Tool Output Controls** . 6. Record the fuel pressure indicated by the fuel pressure gage after the fuel injector has stopped pulsing. 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. Is the difference between any individual pressure drop and the average pressure drop more than the specified value?	10 kPa (1.5 psi)	Go to **Step 8**	Go to **Symptoms - Engine Controls**
8	Replace the affected fuel injectors. Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Start the engine. 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Does an engine performance concern still exist?	-	System OK	Go to **Symptoms - Engine Controls**

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 complete one test cycle. The malfunction indicator lamp (MIL) will illuminate after the EVAP diagnostics complete two test cycles.

Diagnostic Aids

- Operate the vehicle under the condition of the customer's concern. Under high temperature conditions the 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 the EVAP purge is enabled, all fuel vapor release would be eliminated.
- Movement of the EVAP pipes or the 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 in order to determine that no EVAP diagnostic trouble code (DTC) is present.

3: This test locates fuel leakage in the fuel pipes.

4: This tests for fuel leaks below the fuel tank fuel level.

5: This test locates 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-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
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 the fuel pipes for damage or external leaks. Did you find fuel leaking from the fuel tank?	Go to **Step 6**	Go to **Step 3**
	1. Turn ON the ignition, with the engine OFF.		

3	2. Command the fuel pump relay ON with a scan tool. 3. Inspect for fuel leaking from the fuel pipes. Did you find fuel leaking from the fuel pipes?	Go to **Step 7**	Go to **Step 4**
4	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the J41415-50 is available, start the diagnosis at the fuel fill cap.** 3. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. • Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 4. Turn ON the ignition with the engine OFF. 5. Command the EVAP vent valve closed with a scan tool. **IMPORTANT:** **DO NOT exceed 15 inches H2O.** 6. Use the remote switch to introduce nitrogen into the fuel tank. Did fuel leak from the fuel tank?	Go to **Step 6**	Go to **Step 5**
	IMPORTANT: **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition.		

5	2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the J41415-50 is available, start the diagnosis at the fuel fill cap.** 3. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Turn ON the ignition with the engine OFF. 5. Command the EVAP vent valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 7. Use the remote switch to introduce smoke into the fuel system for 60 seconds. 8. Inspect the entire EVAP/fuel system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 9. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to **Step 8**	Go to Diagnostic Aids
6	Replace the fuel tank. Refer to **Fuel Tank Replacement** . Did you complete the replacement?	Go to **Step 8**	-
7	Replace the leaking fuel pipe. Refer to **Fuel Hose/Pipes Replacement - Chassis** . Did you complete the replacement?	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

The concentration of alcohol-in-fuel can be detrimental to the fuel system. Higher than recommended alcohol-in-fuel concentrations may cause driveability problems such as hesitation, lack of power, stall, no start, etc. High concentrations may also cause corrosion of the fuel system components and subsequent fuel filter plugging as well as deterioration of the rubber and the plastic components.

Commercial automotive fuel can contain alcohol in various types and levels of concentration. Some forms of alcohol are more detrimental to the fuel system components than others. If an excessive amount of alcohol-in-

fuel is suspected as the cause of a driveability problem, the following procedure can be used to detect its presence. This procedure uses water to extract the alcohol from the fuel. The specific type of alcohol contamination cannot be determined from this test.

Testing Procedure

The fuel sample should be drawn from the bottom of the fuel tank, because any water present in the tank will be concentrated there. The fuel sample should be bright and clear. If the sample appears to be cloudy or contaminated with the water as indicated by a water layer at the bottom of the sample, this procedure should not be used. The fuel system should be cleaned. Refer to **Fuel System Cleaning** .

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

If there is alcohol present in the fuel, the volume of the lower layer, which will 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 will indicate that there is at least 5 percent alcohol in the fuel. The actual amount of the alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

Circuit Description

The powertrain control module (PCM) controls the 6 individual coil assemblies using reference pulses from the crankshaft position (CKP) sensor and other sensor inputs. Ignition 1 voltage is applied to the ignition coil assemblies when the ignition switch is in the ON or START positions. The ignition control module within each coil assembly toggles the primary windings, inducing a high voltage in the secondary windings. The high voltage induced in the secondary windings of the ignition coils is applied through the coil boots to the spark plugs.

Diagnostic Aids

Inspect for the following conditions:

If the operation of the ignition system is intermittent, check for a reliable reference signal from the crankshaft position (CKP) sensor while cranking the engine. The PCM relies on the CKP sensor for engine reference. Without continuous accurate reference signals, there is no reliable spark or fuel injector pulse. The scan tool engine speed display should be more than 200 RPM while cranking. If erratic values, such as sudden spikes in engine speed are displayed, the engine reference signal may not be stable enough for the engine to start and run

properly. Inspect the CKP sensor signal circuits for electromagnetic interference (EMI) or poor electrical connections.

A vehicle that starts and runs after being brought to the shop for an engine cranks but will not run concern, may have an ignition system that is susceptible to moisture. Spray water on the ignition system components and wiring in order to check for an engine miss or stall.

An intermittent malfunction may be caused by a condition in the ignition system electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .

Test Description

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

4: If the PCM does not detect a signal from either CKP sensor, the engine will not start. Damage wiring or a sensor that is disconnect causes this condition. If an engine speed is observed, there is no voltage available to the ignition coils. An open fuse in the supply circuit causes a no start and no communication with the scan tool.

5: This step is tests for a condition with the control circuit of the ignition coil. If the voltage is not within the specified range, There is a condition with the control circuit of the ignition coil.

16: After replacing the PCM, a new minimum throttle position and idle speed must be established.

Electronic Ignition (EI) System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **This diagnostic procedure only diagnosis an inoperative ignition coil or a no start condition.** Were you sent here from Engine Cranks but Does Not Start?	-	Go to **Step 4**	Go to **Step 3**
3	Were you sent here from DTC P0301-P0306?	-	Go to **Step 5**	Go to **DTC P0301-P0306** or **Engine Cranks but Does Not Run**
4	Crank the engine over for 10 seconds, while you observe the engine speed parameter with a scan tool. Is engine speed displayed on the scan tool?	-	Go to **Step 12**	Go to **Step 13**
	1. Turn OFF the ignition.			

5	2. Disconnect the ignition coil from the cylinder that is misfiring. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the ignition control circuit of the ignition coil and B+ with a DMM. Is the voltage within the specified range?	6.5-7.5V	Go to **Step 6**	Go to **Step 8**
6	Probe the ignition 1 voltage circuit of the ignition coil with a test lamp connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 11**
7	Probe the ground circuit of the ignition coil with a test lamp connected to B+. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 14**
8	Test the control circuit of the ignition coil for an open, short to ground, short to voltage, or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
9	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 17**	Go to **Step 15**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
11	1. Repair the ignition 1 voltage circuit of the ignition coil for one of the following conditions • For an open • For a short to ground • For high resistance 2. Refer to **Wiring Repairs** in Wiring Systems. 3. Replace the fuse if necessary. Did you complete the repair?	-	Go to **Step 17**	-
12	Repair the open ignition 1 voltage circuit between the splice pack 113 and the fuse. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-

13	Repair the damage circuits of the crankshaft position (CKP) sensor or connect the CKP sensor. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
14	Repair the open ground circuit of the ignition coil. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
15	Replace the ignition coil. Refer to the appropriate procedure: • **Ignition Coil(s) Replacement - Bank 1** • **Ignition Coil(s) Replacement - Bank 2** Did you complete the replacement?	-	Go to **Step 17**	-
16	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 17**	-
17	Operate the vehicle in order to verify the repair Does a driveability condition still exist?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM CHECK

Description

Several states require that a vehicle pass on-board diagnostic (OBD) system tests and the 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 complies with the local area requirements.

Conditions for Updating the I/M System Status

Each system requires at least one, and sometimes several, diagnostic tests. The results of these tests are reported by a diagnostic trouble code (DTC). A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or any one of the DTCs comprising the monitor have illuminated the malfunction indicator lamp (MIL). Once all of the tests are completed, the I/M System Status display will indicate YES in the Completed column. For example, when the HO2S Heater Test indicates YES, all of the oxygen sensor heaters have been diagnosed. If the vehicle has four heated oxygen sensors, all four heater circuits have been

diagnosed. 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 as part of a service procedure.

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:

- Air conditioning system
- Catalytic converter efficiency
- Comprehensive component monitoring - Emission related inputs and outputs
- Evaporative emissions (EVAP) system
- Exhaust gas recirculation (EGR) system
- Fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- Oxygen sensor system (O2S or HO2S)
- Oxygen sensor heater system (HO2S heater)
- Secondary air injection (AIR) system

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 on some vehicles and may not require an indicator.

Diagnostic Aids

The I/M System Status display provides an indication of when the control module has completed the required tests. This does not necessarily mean that the test has passed, only that a decision was made. If the diagnostic fails, a DTC will indicate the failure. If a failure indication is present for a DTC associated with one of the I/M regulated systems, the DTC may prevent other required tests from running. For example, a DTC for the control circuit of the relay controlling an AIR pump may not be listed in the Inspection/Maintenance System DTC Table because the DTC is a continuous test. If this DTC is set, the Active Tests for the AIR system may not run.

The I/M System Status information may be useful for a technician to determine if diagnostics have run when verifying repairs.

Test Description

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

1: Any DTCs set, even those that are not listed in the Inspection/Maintenance System DTC Table, may prevent the required DTCs from running. If there is any question as to whether a set DTC is disabling the required I/M diagnostic, review the Conditions for Running in the diagnostic procedures for the DTC required by the I/M diagnostic. A list of disabling DTCs, if applicable, is contained in the supporting text for that DTC.

2: Anytime a control module is reprogrammed or the diagnostic trouble codes are cleared as part of a repair procedure, all the I/M System Status indicators will reset to NO.

3: Use discretion when determining whether the entire system set procedure needs to be performed. For example, if the only tests that have not run are those that require the engine to be at operating temperature, then only those individual tests need to be run. There is no need to allow the engine to completely cool in order to run these tests.

Inspection/Maintenance (I/M) System Check

Step	Action	Yes	No
1	1. Perform **Diagnostic System Check - Engine Controls** . **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 I/M readiness. 2. Perform any repairs indicated by the service bulletins. Was a repair service required?	Go to **Inspection/Maintenance (I/M) Complete System Set Procedure**	Go to **Step 3**
	With a scan tool, observe the I/M System Status		Go to the I/M

3	display. Is more than one test indicating a NO status?	Go to **Inspection/Maintenance (I/M) Complete System Set Procedure**	System Set Procedure for the indicated system

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

Description

The purpose of the 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

- The intake air temperature (IAT) is at least -7°C (20°F).
- The engine coolant temperature (ECT) is at least 70°C (158°F).
- The vehicle is driven at a steady speed above 40 km/h (25 mph).
- The battery voltage is between 10.5-16 volts.

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 (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 Catalyst Test. The procedure instructs the technician to operate the vehicle in the enable conditions for 6 minutes. If the test updates 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 in the diagnostic table.

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result in difficulty updating the status to YES.

2: This step is to run the heated oxygen sensor (HO2S) Heater tests and evaporative emission (EVAP) System tests.

3: This step is to run the Catalyst test. The Catalyst test runs during the specified cruise period.

4: This step is to set up the Oxygen Sensor (O2S) tests. These tests run during the idle period immediately following a cruise period that meets a minimum calibrated RPM and time period.

5: This step is to run the Oxygen Sensor tests and the EVAP Tests. These tests run during the idle period immediately following a cruise period that meets a minimum calibrated RPM and time period.

6: Perform the individual system test for any of the systems that do not update to YES.

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
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. Set the vehicle parking brake. 3. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 4. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. **IMPORTANT:** **Once the engine is started, DO NOT turn OFF the engine for the remainder of the procedure until the test is complete.** 5. Start and idle the engine. 6. Idle the engine until the engine reaches an operating temperature of at least 70°C (158°F). This may be up to 8-10 minutes depending on the start up coolant temperature. Is the action complete?	2 minutes	Go to **Step 3**	-
	CAUTION: **Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:**			

3	**In order for the remaining portion of this test to run, the vehicle must operate in the following conditions:** 1. Acceleration at part throttle to 56-90 km/h (45-55 mph). 2. Speed maintained for 4 minutes or until the I/M System Status indicator updates to YES Is the action complete?	-	Go to **Step 4**	-
4	**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. Deceleration to 0 km/h (0 mph). 2. 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 5**	-
5	**CAUTION:** **Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:** **In order for the remaining portion of this test to run, the vehicle must operate in the following conditions:** 1. Acceleration at part throttle to 56-90 km/h (45-55 mph). 2. Speed maintained for 4 minutes or until the I/M System Status indicator	-		

	updates to YES Is the action complete?		Go to **Step 6**	-
6	With a scan tool, observe the I/M System Status display. 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
7	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
Catalyst	**DTC P0420 or P0430**
EVAP	**DTC P0442** **DTC P0443** **DTC P0446** **DTC P0452** **DTC P0453** **DTC P0455** **DTC P0496** **DTC P0498** **DTC P0499**
EGR	**DTC P0401** **DTC P0403** **DTC P0404** **DTC P0406**
Oxygen Sensor	**DTC P0133 or P0153** **DTC P0135 or P0155** **DTC P0137 or P0157** **DTC P0138 or P0158** **DTC P0139 or P0159** **DTC P0141 or P0161** **DTC P2238 or P2241** **DTC P2239 or P2242** **DTC P2243 or P2247** **DTC P2245 or P2249** **DTC P2252 or P2255** **DTC P2253 or P2256** **DTC P2297 or P2298** **DTC P2414** **DTC P2415**

	DTC P2627 or P2630 **DTC P2628 or P2631**
Oxygen Sensor Heater	**DTC P0030, P0036, P0050, or P0056**

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

Description

The purpose of this test is to satisfy the enable criteria necessary to execute I/M readiness diagnostics for the Catalyst System. The test may be used to set the I/M System Status indicators to YES. Ensure the vehicle meets the requirements listed in Conditions for Running before performing this test. Failure to meet the necessary requirements may produce inaccurate test results.

Conditions for Running

- The intake air temperature (IAT) is at least -7°C (20°F).
- The engine coolant temperature (ECT) is at least 70°C (158°F).
- The vehicle is driven at a steady speed above 40 km/h (25 mph).

Diagnostic Aids

If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

The I/M System Status does not indicate whether the test has passed or failed, only that a decision was made. 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 required tests have not run. When a failure occurs, the Emission Related DTC portion of the I/M System Status display will indicate the malfunction indicator lamp (MIL) is requested. The I/M System Status also registers the number of diagnostic trouble codes (DTCs).

The first failure of a type B DTC does not constitute a final determination of pass or fail, and will not update the I/M System Status to YES. A second trip is required, and all the conditions to run must be met in order for the test to run again. These conditions may include a partial to complete engine cool down.

The I/M System Status will update only when an emission related DTC fails the second time, or when all of the tests pass.

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 an A/C compressor clutch turning ON, may cause the test to abort.

If a diagnostic test is difficult to run, maintain necessary enable conditions until the system status updates to YES.

Test Description

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

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result in difficulty updating the status to YES.

2: The Catalyst test runs during the specified cruise period.

3: This step is to identify a first failure of a type B DTC. A DTC only appears on the I/M System Status display when the DTC becomes a MIL illuminating DTC. This occurs on the second failure of a type B DTC. A first failure of a type B DTC will not allow the I/M System Status to update to YES. Refer to Diagnostic Aids.

4: This step is to help identify any unique or unusual criteria required to run the diagnostic test in the event the universal set procedure does not. This information is located in the service information under Conditions for Running the DTC.

5: 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) 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**
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 and idle the engine. **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:** 4. Idle the engine for 1 minute after reaching the operating temperature of 70°C (158°F). 5. Acceleration at part throttle to at least 40-90 km/h (25-55 mph) with short periods of steady speeds along with stop and go driving. This driving pattern maintained for 2-3 minutes or until the I/M System Status updates to YES.		

	6. With a scan tool, observe the I/M System Status display. Did the Catalyst System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	With a scan tool, observe the DTC Information. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	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. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 3. Repeat the procedure until the scan tool indicates the diagnostic test has run. 4. With a scan tool, observe the I/M System Status display. Did the Catalyst System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	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 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. Ensure the vehicle meets the requirements listed in Conditions for Running before performing this test. Failure to meet the necessary requirements may produce inaccurate test results.

Conditions for Running

The engine coolant temperature (ECT) is at least 80°C (176°F).

Diagnostic Aids

If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

The I/M System Status does not indicate whether the test has passed or failed, only that a decision was made. 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 required tests have not run. When a failure occurs, the Emission Related DTC portion of the I/M System Status display will indicate the malfunction indicator lamp (MIL) is requested. The I/M System Status also registers the number of diagnostic trouble codes (DTCs).

The first failure of a type B DTC does not constitute a final determination of pass or fail, and will not update the I/M System Status to YES. A second trip is required, and all the conditions to run must be met in order for the test to run again. These conditions may include a partial to complete engine cool down.

The I/M System Status will update only when an emission related DTC fails the second time, or when all of the tests pass.

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 an A/C compressor clutch turning ON, may cause the test to abort.

If a diagnostic test is difficult to run, maintain necessary enable conditions until the system status updates to YES.

Test Description

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

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result in difficulty updating the status to YES.

2: The Catalyst test runs during the specified cruise period.

3: This step is to identify a first failure of a type B DTC. A DTC only appears on the I/M System Status display when the DTC becomes a MIL illuminating DTC. This occurs on the second failure of a type B DTC. A first failure of a type B DTC will not allow the I/M System Status to update to YES. Refer to Diagnostic Aids.

4: This step is to help identify any unique or unusual criteria required to run the diagnostic test in the event the universal set procedure does not. This information is located in the service information under Conditions for Running the DTC.

5: 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) 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 and idle the engine. **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:** 4. Idle the engine for 1 minute after reaching the operating temperature of 80°C (176°F). 5. Acceleration at part throttle to at least 80-100 km/h (50-62 mph) with short periods of steady speeds along with stop and go driving. This driving pattern maintained for 2-3 minutes or until the I/M System Status updates to YES. 6. Decelerate from 100 km/h (62 mph). The deceleration must last 5 seconds with a fully closed throttle valve. 7. Check for DTCs or until the I/M System Status updates to YES. 8. With a scan tool, observe the I/M System Status display. Did the Catalyst System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	With a scan tool, observe the DTC Information. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	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. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 3. Repeat the procedure until the scan tool indicates the diagnostic test has run.		

	4. With a scan tool, observe the I/M System Status display. Did the Catalyst System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) EVAPORATIVE EMISSION (EVAP) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute 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. Service Bay Tests are included on the scan tool for some systems depending upon vehicle make and model. The test is designed to allow the EVAP Diagnostic Tests to run in service bay conditions. Ensure the vehicle meets the requirements listed in Conditions for Running before performing either EVAP System Test. Failure to meet the necessary requirements may produce inaccurate test results.

Conditions for Running

Non Scan Tool Service Bay Test equipped vehicles

- The barometric pressure (BARO) is more than 75 kPa.
- The engine coolant temperature (ECT) is at least 70°C (158°F) after engine warm up.
- The fuel level is between 1/4 and 3/4.
- The battery voltage is between 10.5-16 volts.
- The vehicle has been driven for at least 20 minutes.
- The test will initiate only after a cold start. The engine coolant temperature (ECT) is between 10-35°C (50-95°F) and the ECT and intake air temperature (IAT) are near the same temperature.

Diagnostic Aids

Extreme high or low ambient temperatures may prevent the EVAP System Tests from initiating. Performing a visual inspection prior to running the EVAP System Set Procedure may prevent having to repeat the test. A loose fuel cap may cause a test to abort or fail and prevent the I/M System Status from updating. A failed or aborted test will require the vehicle to cool down in order to meet the enable criteria to run another test.

The I/M System Status does not indicate whether the test has passed or failed, only that a decision was made. 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 required tests have not run. When a failure occurs, the Emission Related DTC portion of the I/M System Status display will indicate the malfunction indicator lamp (MIL) is

requested. The I/M System Status also registers the number of diagnostic trouble codes (DTCs).

The first failure of a type B DTC does not constitute a final determination of pass or fail, and will not update the I/M System Status to YES. A second trip is required, and all the conditions to run must be met in order for the test to run again. These conditions may include a partial to complete engine cool down.

The I/M System Status will update only when an emission related DTC fails the second time, or when all of the tests pass.

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 an A/C compressor clutch turning ON, may cause the test to abort.

If a diagnostic test is difficult to run, maintain necessary enable conditions until the system status updates to YES.

Test Description

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

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result in difficulty updating the status to YES.

2: The EVAP System test runs immediately following the idle period.

3: This step is to identify a first failure of a type B DTC. A DTC only appears on the I/M System Status display when the DTC becomes a MIL illuminating DTC. This occurs on the second failure of a type B DTC. A first failure of a type B DTC will not allow the I/M System Status to update to YES. Refer to Diagnostic Aids.

4: This step is to help identify any unique or unusual criteria required to run the diagnostic test in the event the universal set procedure does not. This information is located in the service information under Conditions for Running the DTC.

5: 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) 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**
	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.		

2	**IMPORTANT:** **Once the engine is started, DO NOT turn OFF the engine for the remainder of the procedure until the test is complete.** 3. Start and idle the engine. **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:** 4. Idle the engine until the engine reaches operating temperature of at least 70°C (158° F). This may be up to 8-10 minutes depending on the start up coolant temperature. 5. Acceleration at part throttle to 48-80 km/h (30-50 mph) and cruise for 3 minutes after the engine reaches operating temperature. 6. Deceleration to 0 km/h (0 mph). 7. Engine idling for 1 minute while the following criteria is maintained: • Service brake depressed • Automatic transmission in drive • Manual transmission in neutral with the clutch pedal depressed 8. Accelerate at part throttle to 64-72 km/h (40-45 mph) with this speed maintained for 1 minute. 9. With a scan tool, observe the I/M System Status display. Did the EVAP System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	With a scan tool, observe the DTC Information. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
	1. Refer to the **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete		

4	this test. 2. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 3. Repeat the procedure until the scan tool indicates the diagnostic test has run. 4. With a scan tool, observe the I/M System Status display. Did the EVAP System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	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 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. Ensure the vehicle meets the requirements listed in Conditions for Running before performing this test. Failure to meet the necessary requirements may produce inaccurate test results.

Conditions for Running

- The engine coolant temperature (ECT) is at least 70°C (158°F).
- The battery voltage is between 10.5-16 volts.

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 within the allotted period of time, continue operation within the enable conditions until the test updates to YES. 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 from initiating. The oxygen sensor heaters are operated by the engine control module. The control module has the ability to monitor the current required by the heaters and does this on a continuous basis.

The I/M System Status does not indicate whether the test has passed or failed, only that a decision was made. 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 required tests have not run. When a failure occurs, the Emission Related DTC portion of the I/M System Status display will indicate the malfunction indicator lamp (MIL) is requested. The I/M System Status also registers the number of diagnostic trouble codes (DTCs).

The first failure of a type B DTC does not constitute a final determination of pass or fail, and will not update the I/M System Status to YES. A second trip is required, and all the conditions to run must be met in order for the test to run again. These conditions may include a partial to complete engine cool down.

The I/M System Status will update only when an emission related DTC fails the second time, or when all of the tests pass.

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 an A/C compressor clutch turning ON, may cause the test to abort.

If a diagnostic test is difficult to run, maintain necessary enable conditions until the system status updates to YES.

Test Description

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

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result in difficulty updating the status to YES.

2: Preprogramming the scan tool will reduce the amount of time the oxygen sensor heaters operate while verifying the enable criteria. The HO2S Heater Tests may not complete when initiated from a cold start and may require running under a load in order to complete the tests.

3: This step is to identify a first failure of a type B DTC. A DTC only appears on the I/M System Status display when the DTC t becomes a MIL illuminating DTC. This occurs on the second failure of a type B DTC. A first failure of a type B DTC will not allow the I/M System Status to update to YES. Refer to Diagnostic Aids.

4: This step is to help identify any unique or unusual criteria required to run the diagnostic test in the event the universal set procedure does not. This information is located in the service information under Conditions for Running the DTC.

5: 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) Heated Oxygen Sensor/Oxygen Sensor (HO2S/O2S) 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 **Inspection/Maintenance (I/M) System Check**
	IMPORTANT: **Once the engine is started, DO NOT turn OFF the engine for the remainder of the procedure until the test is complete.**			

2	1. Start and idle the engine. 2. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 3. Set the vehicle parking brake. 4. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 5. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 6. Start and idle the engine. 7. Idle the engine for the specified value and then check for DTCs. Did the HO2S Heater System Status update to YES?	2 minutes	Go to **Step 5**	Go to **Step 3**
3	With a scan tool, observe the DTC information. Does the scan tool indicate any failed DTCs?	-	Go to **Diagnostic Trouble Code (DTC) List**	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. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 3. Repeat the procedure until the scan tool indicates the diagnostic test has run. 4. With a scan tool, observe the I/M System Status display. Did the HO2S Heater System Status update to YES?	-	Go to **Step 5**	Go to Diagnostic Aids
5	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	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 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. Ensure the vehicle meets the requirements listed in Conditions for Running before performing this test. Failure to meet the necessary requirements may produce inaccurate test results.

Conditions for Running

- The engine coolant temperature (ECT) is at least 60°C (140°F).
- The battery voltage is between 10.5-16 volts.

Diagnostic Aids

If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

The I/M System Status does not indicate whether the test has passed or failed, only that a decision was made. 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 required tests have not run. When a failure occurs, the Emission Related DTC portion of the I/M System Status display will indicate the malfunction indicator lamp (MIL) is requested. The I/M System Status also registers the number of diagnostic trouble codes (DTCs).

The first failure of a type B DTC does not constitute a final determination of pass or fail, and will not update the I/M System Status to YES. A second trip is required, and all the conditions to run must be met in order for the test to run again. These conditions may include a partial to complete engine cool down.

The I/M System Status will update only when an emission related DTC fails the second time, or when all of the tests pass.

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 an A/C compressor clutch turning ON, may cause the test to abort.

If a diagnostic test is difficult to run, maintain necessary enable conditions until the system status updates to YES.

Test Description

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

1: Make sure you perform the I/M System Check before performing this test. Failure to do so may result

in difficulty updating the status to YES.

2: The oxygen sensor tests begin during the idle period immediately following the cruise period.

3: This step is to identify a first failure of a type B DTC. A DTC only appears on the I/M System Status display when the DTC becomes a MIL illuminating DTC. This occurs on the second failure of a type B DTC. A first failure of a type B DTC will not allow the I/M System Status to update to YES. Refer to Diagnostic Aids.

4: This step is to help identify any unique or unusual criteria required to run the diagnostic test in the event the universal set procedure does not. This information is located in the service information under Conditions for Running the DTC.

5: 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) Heated Oxygen Sensor (HO2S) Heater 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 and idle the engine. 4. Acceleration at part throttle to at least 40-90 km/h (25-55 mph) with short periods of steady speeds along with stop and go driving. 5. Decelerate for at least 5 seconds after 2-3 minutes. Check for DTCs or until the I/M System Status updates to YES. 6. With a scan tool, review the I/M System Status display. Did the HO2S/O2S System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	With a scan tool, observe the DTC Information. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 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. Operate the vehicle within the Conditions		

4	for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 3. Repeat the procedure until the scan tool indicates the diagnostic test has run. 4. With a scan tool, observe the I/M System Status display. Did the HO2S/O2S System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	With a scan tool, observe the Emission Related DTC portion of the I/M System Status display. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	System OK