2004 ENGINE PERFORMANCE

Engine Controls (Troubleshooting) - 4.2L - Ascender

ENGINE CONTROLS (TROUBLESHOOTING)

SYMPTOMS - ENGINE CONTROLS

Important Preliminary Checks Before Starting

Before using the Symptom tables use the following:

- Perform **Diagnostic System Check - Engine Controls** and verify all of the following items:
  - Ensure no DTCs are stored.
  - The scan tool data is within normal operating range. Refer to **Scan Tool Data List** .
- Verify the customer complaint.
- Perform the Visual/Physical Check in this section.

Locate the correct symptom in the list at the end of this section. Follow the procedures in the appropriate diagnostic table. If the condition can not be duplicated or is determined to be intermittent, refer to **Intermittent Conditions** .

Visual/Physical Check

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

- Inspect the PCM grounds for being clean, tight, and in their proper location. Refer to **Power and Grounding Component Views** in Wiring Systems.
- Inspect vacuum hoses for splits, kinks, and proper connections, as shown on Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking, especially between the mass air flow (MAF) sensor and the throttle body.
- Inspect for air leaks at throttle body mounting area, mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for poor connections, pinches, cuts, or other damage.
- Inspect for loose, damaged, or missing sensors and/or components.

Use the following tables when diagnosing a symptom complaint:

- **Intermittent Conditions**
- **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**
- **Engine Cranks but Does Not Run**
- **Malfunction Indicator Lamp (MIL) Inoperative**
- **Malfunction Indicator Lamp (MIL) Always On**

INTERMITTENT CONDITIONS

Intermittent Conditions

Inspection or Test	Action
DEFINITION: Whether the symptom is a DTC or a customer complaint, the condition cannot be duplicated.	
Preliminary	Perform the Diagnostic System Check-Engine Controls before starting. Refer to **Diagnostic System Check - Engine Controls** .
Harness or Connector	Many intermittent open or shorted circuits come and go with harness or connector movement caused by the following type conditions: • Vibration • Engine torque • Bumps or rough pavement Test for intermittents by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. Verify whether the harness or connector movement affects any of the following systems:

	• Data displayed • Component or system operation • Engine operation Repair the components as necessary. Refer to Electrical Connections or Wiring in this table.

Electrical Connections or Wiring	• Intermittents are usually caused by one or more of the following conditions:
	  ○ Poor electrical connections
	  ○ Terminal tension
	  ○ Wiring problems
	• Carefully inspect the suspected circuit for the following conditions:
	  ○ Poor mating of the connector halves
	  ○ Terminals backed out or not fully seated in the connector body
	  ○ Improperly formed or damaged terminals-Test for poor 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 in the harness
	  ○ Wiring that is in contact with hot exhaust components
	• Repair the condition as necessary. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems.

Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power circuits that may also need to be tested. Inspect connections at the module or component connectors, fuses, and any intermediate connections between the power source and the module 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 control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Ground Distribution Schematics** in Wiring Systems.
Temperature Sensitivity	• An intermittent condition may occur when a component or connection reaches normal operating temperature. The condition may occur only when the component or connection is cold, or only when the connection is hot. • The following data may help to diagnose this type of intermittent condition: o Freeze Frame/Failure Records o Scan tool snapshot o Vehicle data recorder • If the intermittent is related to heat, review the following data: o High ambient temperatures o Underhood or engine generated heat o Circuit generated heat due to a poor connection, or high electrical load o Higher than normal load conditions, such as towing • If the intermittent is related to cold, review the following data: o Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. o The condition only occurs on a cold start. o The condition is not present after the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise.	Some electrical components or circuits are sensitive to electromagnetic interference (EMI) or other types of electrical noise. Perform the following procedures: • Inspect for a misrouted harness that is too close to a high voltage or high current device. This condition may induce electrical noise on a circuit that could interfere with normal circuit operation.

	Inspect for wires that are too close to the following devices: ○ Secondary ignition components ○ Motors ○ The generator • Determine whether the electrical system interference is caused by a malfunctioning relay, PCM driven solenoid or switch. These components may cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating. • Determine whether non-factory or aftermarket add-on accessories are installed in the vehicle. These accessories may lead to an emission related OBD II failure. Determine if any of the following non-factory or aftermarket add-on accessories is causing the intermittent: ○ Lights ○ 2-way radios ○ Amplifiers ○ Electric motors ○ Remote starters ○ Alarm systems ○ Cell phones • Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode. • Test for proper performance of the generator. Refer to **Diagnostic System Check - Engine Electrical** in Engine Electrical. • If a DTC is determined to be intermittent, and the tests in this section do not reveal a condition, refer to Vehicle Data Recorder later in this table. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
Incorrect PCM Programming	• There are only a few situations when reprogramming a PCM is appropriate, such as the following: ○ A new service PCM is installed. ○ A PCM from another vehicle is installed. ○ Revised software or calibration files have been released for this vehicle. **IMPORTANT:** **DO NOT re-program the PCM with the same software or calibration files that are already present in the PCM. This is not an effective repair for any type of driveability problem.**

	• Verify that the PCM contains the correct software or calibration. If incorrect programming is found, reprogram the PCM with the most current software or calibration. Refer to **Service Programming System (SPS)** in Programming.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate or capture the failure conditions. • Freeze Frame/Failure Records, where applicable, contains the conditions that were present when the DTC set. Perform the following procedure: 1. Review and record Freeze Frame/Failure Records. 2. Clear the DTCs using the scan tool. 3. Turn the key to OFF and wait 15 seconds. 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text of the DTC being diagnosed. 5. Monitor DTC Status for the DTC being tested. The scan tool 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 the DMM connected to a suspected circuit. An abnormal reading on the DMM when the condition occurs, may help you locate the condition.
Scan Tool Snapshot	The scan tool can be 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.
Vehicle Data Recorder	The **J 42598** Vehicle Data Recorder is connected to the data link connector (DLC) and sent with the customer. The **J 42598** captures data for later retrieval and analysis by the technician. Refer to the vehicle data recorder user instructions for more information.

HARD START

Hard Start

Inspections	Action
DEFINITION: The engine cranks normally, but does not start in a normal amount of time. The engine does eventually run, or may start but immediately dies.	
Preliminary	• Refer to Important Preliminary Check Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Make sure the vehicle operator is using the correct starting procedure.
Sensor/System	Monitor the engine coolant temperature (ECT) sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5 degrees more or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit.
Fuel System	• Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect the fuel pump relay for proper operation. The fuel pump should operate for the first 2 seconds when turning ON the ignition. Refer to **Fuel Pump Electrical Circuit Diagnosis** . • Test the fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for water contamination in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . • Perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Tech 2** . • Inspect the fuel pump check valve. Refer to **Fuel System Diagnosis** .
Ignition System	• Inspect the spark plugs for the following conditions: o Wet plugs o Cracks o Wear o Improper gap o Burned electrodes o Heavy deposits Refer to **Spark Plug Inspection** . • Inspect for loose ignition coil connections.

	• Inspect for loose ignition control module connections. • Inspect for a faulty control module or ignition system grounds.
Engine Mechanical	• Inspect for the following conditions: • Improper valve timing • Low compression-Refer to **Engine Compression Test** in Engine Mechanical. • Worn rocker arms-Refer to **Valve Rocker Arm and Valve Lash Adjuster Cleaning and Inspection** in Engine Mechanical. • Broken or weak valve springs • Worn camshaft lobes-Refer to **Camshafts Cleaning and Inspection** in Engine Mechanical. • Proper Cam Phaser operation-Refer to **Exhaust Camshaft Position Actuator Description** in Engine Mechanical.
Additional	Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust.

SURGES/CHUGGLES

Surges/Chuggles

Inspections	Action
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal position.	
Preliminary Inspections	• Refer to **Symptoms - Engine Controls** . • Be sure that the driver understands the torque converter clutch operation. • Be sure that the driver understands the A/C compressor operation. • Ensure that the transmission fluid is at the proper level.
Sensor/System	Display the scan tool parameters for the various engine controls sensors. Inspect for any abnormal readings.
Fuel System	• Inspect for a rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the fuel trim will help identify the condition. • Lean - The long term fuel trim will be more than 150. • Rich - The long term fuel trim will be less than 115. • Test the fuel pressure while the condition exists. Refer to **Fuel System Diagnosis** . • Inspect the in-line fuel filter for a restrictions.
Ignition System	• Inspect the spark plugs. Remove the plugs and inspect for the following conditions:

	• Wetness • Cracks • Wear • Improper gap • Burned electrodes • Heavy deposits Refer to **Spark Plug Inspection** .
Additional	• Inspect the control module grounds for being clean, tight, and in their proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems. • Test the generator output voltage. Refer to **Diagnostic System Check - Engine Electrical** in Engine Electrical. • Inspect the vacuum hoses for kinks or leaks. • Inspect the torque converter clutch (TCC) operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission. • Inspect the exhaust system for a possible restriction. Refer to **Restricted Exhaust** in Engine Exhaust.

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Lack of Power, Sluggishness, or Sponginess

Inspections	Action
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary	• Refer to **Symptoms - Engine Controls** . • Compare the customer vehicle with a similar unit. Verify the customer concern. • Remove the air filter and check for dirt or a restriction. • Inspect the transmission shift pattern and the downshift operation. Refer to **Symptoms - Automatic Transmission** in Automatic Transmission.
Fuel System	• Inspect for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to **Fuel System Diagnosis** . • Perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Tech 2** and **Fuel Injector Balance Test with Special Tool** .
Exhaust System	• Inspect 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.
Additional	• Inspect the control module grounds for being clean, tight, and in their proper location. Refer to **Power and Grounding Component Views** in Wiring Systems. • Inspect the torque converter clutch (TCC) operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission. • Inspect the A/C operation. Refer to **HVAC Compressor Clutch Does Not Engage** or **HVAC Compressor Clutch Does Not Disengage** in HVAC Systems- Manual. • Monitor the knock sensor (KS) system for retarded timing.
Engine Mechanical	Inspect the engine for the proper operation of the following items: • Engine compression-Refer to **Engine Compression Test** in Engine Mechanical. • Valve timing • Improper or worn camshaft-Refer to **Camshafts Cleaning and Inspection** in Engine Mechanical.

DETONATION/SPARK KNOCK

Detonation/Spark Knock

Inspections	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary	• Refer to **Symptoms - Engine Controls** . • Verify the customer's concern.
Cooling System	• Inspect for a low engine coolant level. • Inspect for a correct coolant mixture. • Inspect for the proper tension on the drive belts. Refer to **Drive Belt Tensioner Diagnosis** in Engine Mechanical. • Inspect for restricted air flow through the radiator, or restricted coolant flow. • Inspect for a faulty thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling.
Sensor/System	Inspect for an engine coolant temperature (ECT) sensor that has a shift in value. Refer to **Temperature vs Resistance** .
Fuel System	• 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 150.

	• Test the fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a poor fuel quality and a proper octane rating. • If the fuel trim readings are normal and there are no engine mechanical concerns, then fill the fuel tank with a known good fuel and re-evaluate the vehicle performance.
Ignition System	• Inspect the spark plugs for their proper heat range and gap. • Inspect the knock sensor (KS) system operation. • Inspect the ignition timing.
Engine Mechanical	• Inspect for carbon build up. Remove the carbon with a top engine cleaner. Follow the instructions on the can. • Test the combustion chamber pressure by performing a compression test. Refer to **Engine Compression Test** in Engine Mechanical.
Additional	• Inspect the torque converter clutch (TCC) operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission. • Search for Service Bulletins for calibration updates.

HESITATION, SAG, STUMBLE

Hesitation, Sag, Stumble

Inspections	Action
DEFINITION: The vehicle has a momentary lack of response when depressing 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 the condition is severe enough.	
Preliminary	Refer to **Symptoms - Engine Controls** .
Fuel System	• Test the fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect the throttle position (TP) sensor for binding or sticking. Voltage should increase at a steady rate as the throttle moves toward wide open throttle (WOT). • Test for water contamination in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Test the canister purge system for proper operation. • Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . • Test for low fuel pressure after a cold start or during a moderate or full throttle acceleration.
Ignition System	• Inspect for fouled spark plugs.

	• Inspect for proper ignition system performance.
Additional	• Search for Service Bulletins for calibration updates. • Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust.

CUTS OUT, MISSES

Cuts Out, Misses

Inspections	Action
DEFINITION: A jerking that follows engine speed, usually more pronounced as the engine load increases which is not normally felt above 1,500 RPM or 48 km/h (30 mph).	
Preliminary	Refer to **Symptoms - Engine Controls** .
Ignition System	Inspect the spark plugs for the following conditions: • Insulation cracks • Wear • Improper gap • Burned electrodes • Heavy deposits • The ignition system for moisture, dust, cracks, burns, etc.
Engine Mechanical	• Perform a cylinder compression check. Refer to **Engine Compression Test** in Engine Mechanical. • Inspect the engine for the following: o Improper valve timing o Worn rocker arms-Refer to **Valve Rocker Arm and Valve Lash Adjuster Cleaning and Inspection** in Engine Mechanical. o Worn camshaft lobes-Refer to **Camshafts Cleaning and Inspection** in Engine Mechanical. o Broken or weak valve springs-Refer to **Upper Engine Noise, Regardless of Engine Speed** in Engine Mechanical. • Inspect the intake and exhaust manifold passages for casting flash.
Fuel System	• Test the fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for water contamination in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** .

POOR FUEL ECONOMY

Poor Fuel Economy

Inspections	Action
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected.	
Preliminary	• Refer to **Symptoms - Engine Controls** . • Inspect the air cleaner element, or the filter, for dirt or being plugged. • Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Control Information label. • Discuss the driving habits with the owner for the following items: o The A/C is ON full time, or the defroster mode is ON o The tires for being at the correct air pressure o The wheel and tires are the correct size o Excessively heavy loads being carried o Aggressive driving habits • Suggest to the owner to fill the fuel tank and to inspect the fuel economy. • Suggest to the driver to refer to Important Facts on Fuel Economy in the owner manual.
Fuel System	• Inspect the fuel type, quality, and alcohol content. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Test the fuel pressure. Refer to **Fuel System Diagnosis** .
Ignition System	• Inspect the spark plugs. Remove the spark plugs and check for the following: o Wet plugs o Cracks o Wear o Improper gap o Burned electrodes o Heavy deposits Refer to **Spark Plug Inspection** . • Inspect for an open ignition control (IC) circuit. • Inspect the knock sensor (KS) system operation.
Cooling System	• Inspect the engine coolant level.

	• Inspect the engine thermostat for always being open or for the wrong heat range.
Additional	• Inspect the transmission shift pattern. Refer to **Symptoms - Automatic Transmission** in Automatic Transmission - 4L60-E. • Inspect the torque converter clutch (TCC) operation. Refer to **Torque Converter Diagnosis Procedure** in Automatic Transmission - 4L60-E. • Inspect for proper calibration of the speedometer. • Inspect for dragging brakes. Refer to **Diagnostic Starting Point - Hydraulic Brakes** in Hydraulic Brakes.

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Conditions	Causes
Difficult to fill	• Check valve stuck closed • 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 ON
Over fill	• Pressure relief valve in fill limiter vent valve stuck open • Pressure relief valve in fill limiter vent valve is leaking • Fill limiter vent valve stuck open • Fill limiter vent valve is leaking
Premature 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 ON
Fuel Spitback	• Check valve stuck open • Check valve stuck closed • Check valve leaking • High Reid vapor pressure or high fuel temperature
Liquid to EVAP canister	• Fill limiter vent valve stuck open

	• Fill limiter vent valve leaking
Liquid leak to ground	• Pressure relief valve in fill limiter vent valve stuck open, or leaking • Fuel filler hose loose or torn • Fill limiter vent valve stuck open
Fuel Odor	• Pressure relief in fuel limiter vent valve stuck open, or leaking • Saturated EVAP canister

ROUGH, UNSTABLE, OR INCORRECT IDLE AND STALLING

Rough, Unstable, or Incorrect Idle and Stalling

Inspections	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.	
Preliminary	Refer to **Symptoms - Engine Controls** .
Sensor	• Inspect the heated oxygen sensor (HO2S). Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage, or rich exhaust indication. The control module will reduce the amount of fuel delivered to the engine causing a severe driveability condition. • Inspect the engine coolant temperature (ECT) sensor using the 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 degrees more than or less than the ambient air temperature on a cold engine, test for a high resistance in the coolant sensor circuit or the sensor itself. • Inspect the manifold absolute pressure (MAP) sensor response and accuracy.
Fuel System	• Test the fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect to determine if a rich or lean system causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the fuel trim will help identify the condition. o Lean-The long term fuel trim is more than 150. o Rich-The long term fuel trim is less than 115. • Perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Tech 2** . • Test the fuel injector driver circuit. 1. Disconnect the injector harness connector at the injectors. 2. Connect an injector test lamp between the terminals of each injector connector and note the lamp while cranking.

	3. If the test lamp fails to blink at any connector, it is a faulty injector drive circuit harness, connector, or terminal. • Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . • Inspect the evaporative emission (EVAP) control system. Refer to **Evaporative Emission (EVAP) Control System Description** .
Ignition System	• Inspect the overall ignition system • Inspect for the following conditions: o Wet plugs o Cracks o Wear o Improper gap o Burned electrodes o Blistered insulators o Heavy deposits Refer to **Spark Plug Inspection** .
Additional	• Inspect for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low idle air control (IAC) counts. • Inspect the control module grounds for being clean, tight, and in their proper locations. • Observe the scan tool to determine if the control module is receiving an A/C signal. Refer to **HVAC Compressor Clutch Does Not Engage** or **HVAC Compressor Clutch Does Not Disengage** in HVAC Systems-Manual. If a condition exists with the A/C ON, inspect the A/C system operation. • Inspect the battery cables and ground straps for being clean and secure. • Inspect the crankcase ventilation valve for proper operation by placing a finger over the inlet hole in the valve end several times. The valve should snap back. If not, replace the valve. Refer to **Crankcase Ventilation System Inspection/Description** in Engine Mechanical.
Engine Mechanical	Inspect for the following: • Broken motor mounts-Refer to **Engine Mount Inspection** in Engine Mechanical. • Improper valve timing • Low compression-Refer to **Engine Compression Test** in Engine Mechanical. • Worn rocker arms-Refer to **Valve Rocker Arm and Valve Lash**

	Adjuster Cleaning and Inspection in Engine Mechanical. • Broken or weak valve springs • Worn camshaft lobes-Refer to **Camshafts Cleaning and Inspection** in Engine Mechanical.

DIESELING, RUN-ON

Dieseling, Run-On

Inspections	Action
DEFINITION: The engine continues to run when you turn the key OFF, but runs very roughly. If the engine runs smoothly, test the ignition switch and adjustment.	
Preliminary	Refer to **Symptoms - Engine Controls** .
Fuel System	• Inspect the evaporative emission (EVAP) system and fuel tank venting. • Inspect the fuel injectors for leakage. Refer to **Fuel System Diagnosis** • Perform a fuel system diagnosis. Refer to **Fuel System Diagnosis** .

BACKFIRE

Backfire

Inspections	Action
Definition: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary	Refer to **Symptoms - Engine Controls** .
Ignition System	Inspect the ignition system.
Engine Mechanical	• Inspect the engine for the following the items: o Engine compression-Refer to **Engine Compression Test** in Engine Mechanical. o Improper valve timing o Manifold gaskets o Sticking or leaking valves • Inspect the intake and exhaust system for fresh air entering the exhaust upstream of the catalytic converter or restrictions. Refer to **Symptoms - Engine Exhaust** in Engine Exhaust.
Fuel System	• Inspect the fuel system. Refer to **Fuel System Diagnosis** . • Perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Tech 2** .

MALFUNCTION INDICATOR LAMP (MIL) INOPERATIVE

Circuit Description

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

MIL Operation

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

MIL Function

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

MIL Illumination

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

Test Description

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

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

Malfunction Indicator Lamp (MIL) Inoperative

Step	Action	Values	Yes	No
Schematic Reference: 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. Verify whether the instrument cluster is operational. If the instrument panel (I/P) is completely inoperative, refer to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gages and Console. 2. Command the MIL ON and OFF with a scan tool. Does the MIL turn ON and OFF when commanded with a scan tool?	-	Go to **Intermittent Conditions**	Go to **Step 3**
3	Inspect the fuse that supplies ignition voltage to the cluster. Is the fuse open?	-	Go to **Step 10**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Remove the fuse that supplies voltage to the cluster. 3. Disconnect the powertrain control module (PCM). 4. Turn ON the ignition with the engine OFF. 5. Measure the voltage from the MIL control circuit in the PCM harness connector to a good ground. Is the voltage less than the specified value?	0.3 V	Go to **Step 5**	Go to **Step 11**
5	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the cluster. 3. Turn ON the ignition with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit in the PCM harness connector and a good ground. Is the MIL illuminated?	-	Go to **Step 9**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages, and Console. 3. Probe the ignition voltage circuit of the	-		

	IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?		Go to **Step 7**	Go to **Step 12**
7	Test the MIL control circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the IPC. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
9	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
10	Repair the short to ground in the ignition voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
11	Repair the short to voltage in the MIL control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
12	Repair the open in the ignition voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
13	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages, and Console. Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	Turn OFF the ignition for 30 seconds. Does the vehicle operate correctly, without any MIL illumination and without any stored DTCs?	-	System OK	Go to **Diagnostic Trouble Code (DTC) List**

MALFUNCTION INDICATOR LAMP (MIL) ALWAYS ON

Circuit Description

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

MIL Operation

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

MIL Function

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

MIL Illumination

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

Diagnostic Aids

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

Test Description

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

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

Malfunction Indicator Lamp (MIL) Always On

Step	Action	Yes	No
Schematic Reference: 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**
	1. Turn OFF the ignition.		

2	2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MIL. Is the MIL illuminated?	Go to **Step 3**	Go to **Step 5**
3	1. Remove the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages, and Console. 2. Test the MIL control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	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 6**	-
5	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Turn the ignition OFF for 30 seconds. 2. Start the engine. Does the vehicle operate correctly without any MIL illumination, and without any stored DTCs?	System OK	Go to **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 (Non-HP2)** in Engine Electrical.
- The cranking speed is acceptable. Refer to **Engine Cranks Slowly** in Engine Electrical.
- There is adequate fuel in the fuel tank.

Test Description

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

8: The crankshaft position (CKP) sensor can fail in such a way that will cause the engine to crank but will not run. The engine will be able to run by using the cam sensor when the CKP sensor is disconnected.

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	1. Turn ON the ignition, with the engine OFF. 2. With a scan tool, observe the DTC information. Does the scan tool display DTCs P0068, P0107, P0601, P0602, P0604, P0606, P0607, P0651, P1621, P1631, P1680, P1681, or P1682?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	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 4**
4	Command the fuel pump ON with a scan tool. Does the fuel pump turn ON?	-	Go to **Step 5**	Go to **Fuel Pump Electrical Circuit Diagnosis**
5	1. Turn OFF the ignition. 2. Remove an ignition coil. Refer to **Ignition Coil(s) Replacement** . 3. Install the **J 26792** Spark Tester to the coil boot. 4. Attempt to start the engine. Does the spark tester spark?	-	Go to **Step 6**	Go to **Electronic Ignition (EI) System Diagnosis**
6	1. Turn OFF the ignition. 2. Disconnect the multi-way harness connector of the fuel injectors. 3. Connect a test lamp between the ignition 1 voltage circuit of the fuel injector, fuse side, and a fuel injector control circuit, powertrain control module (PCM) side. 4. Crank the engine.	-		Go to **Fuel**

	Does the test lamp flash when cranking the engine?		Go to **Step 7**	**Injector Circuit Diagnosis**
7	1. Turn OFF the ignition. 2. Install the **J 34730-1A** 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?	334-375 kPa (48-54 psi)	Go to **Step 8**	Go to **Fuel System Diagnosis**
8	1. Disconnect the crankshaft position (CKP) sensor. 2. Attempt to start the engine. Does the engine start and continue to run?	-	Go to **Step 10**	Go to **Step 9**
9	Inspect for the following conditions: • A collapsed air intake duct • A restricted air filter element-Refer to **Air Cleaner Element Replacement** . • Contaminated fuel-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • The spark plugs for being gas or coolant fouled-Refer to **Spark Plug Inspection** . If the spark plugs are fouled, determine what caused the condition. • An engine mechanical condition (worn timing chain, gears and low compression) - Refer to **Symptoms - Engine Mechanical** in Engine Mechanical. • A 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 MAP/BARO parameters to another vehicle. The parameters should be	-		

	close in value. Refer to **DTC P0106** . Did you complete the action?		Go to **Step 11**	-
10	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 11**	Go to **Step 2**
11	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 and continue to run?	-	Go to **Step 12**	Go to **Step 2**
12	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

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

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 two 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: 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. 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.	Go to **Intermittent**	

	Does the fuel pump turn ON and OFF?	**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 19**	Go to **Step 22**
6	Does the test lamp remain illuminated with each command?	Go to **Step 7**	Go to **Step 8**
7	Test the control circuit of the fuel pump relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 26**
8	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 20**
9	Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	Go to **Step 10**	Go to **Step 11**
10	1. Turn OFF the ignition. 2. Remove 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**
11	Inspect the PCM B fuse. Is the fuse open?	Go to **Step 12**	Go to **Step 14**

12	1. Test the supply voltage circuit of the fuel pump for a short to ground between the PCM B fuse and the fuel pump. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the PCM B fuse if necessary. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 13**
13	1. Connect all disconnected electrical components. 2. Install a new PCM B fuse. 3. Command the fuel pump relay ON with a scan tool. 4. Inspect the PCM B fuse. Is the PCM B fuse open?	Go to **Step 24**	Go to **Intermittent Conditions**
14	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 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 15**	Go to **Step 23**
15	Connect a 20-amp fused jumper wire between the ignition 1 voltage circuit of the fuel pump relay and the supply voltage circuit of the fuel pump. Does the fuel pump operate?	Go to **Step 19**	Go to **Step 16**
16	Test the supply voltage circuit of the fuel pump for an open or high resistance between the fuel pump relay and the fuel pump. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 17**
17	**IMPORTANT:** **Inspect the ground circuit for correct tightening, corrosion on the terminals, or damage to the wiring harness.** Test the ground circuit of the fuel pump for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 27**	Go to **Step 18**
	Test for an intermittent and for a poor connection at the fuel sender cover. Refer to **Testing for Intermittent**		

18	**Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 27**	Go to **Step 24**
19	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 27**	Go to **Step 25**
20	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 27**	Go to **Step 26**
21	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 27**	-
22	Repair the open or high resistance in the ground circuit of the fuel pump relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 27**	-
23	Repair the open in the ignition 1 voltage circuit of the fuel pump relay. 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 sender. Refer to **Fuel Sender Assembly Replacement** . 2. Replace the PCM B fuse if necessary. Did you complete the replacement?	Go to **Step 27**	-
25	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 27**	-
26	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 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 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 two seconds if ignition reference pulses cease to be detected and the ignition remains ON.

The fuel tank stores the fuel supply. The electric fuel pump supplies fuel through an in-line fuel filter to the fuel injection system. The pump provides fuel at a higher rate of flow than is needed by the fuel injection system. The fuel pressure regulator maintains the correct fuel pressure to the fuel injection system. A separate pipe returns unused fuel to 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 a 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.**	345-395 kPa (50-57 psi)		

	5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage with the fuel pump commanded ON. Is the fuel pressure within the specified range?		Go to **Step 4**	Go to **Step 10**
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.** 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 **Step 7**	Go to **Step 5**
5	1. Relieve the fuel pressure to the first specified value. 2. Monitor the fuel pressure gage for 5 minutes. Does the fuel pressure decrease by more than the second specified value?	69 kPa (10 psi) 14 kPa (2 psi)	Go to **Step 21**	Go to **Step 6**
6	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 any of the scan tool parameters indicate a lean condition?	-	Go to **Step 15**	Go to **Symptoms - Engine Controls**
7	1. Turn OFF the ignition. 2. Remove the vent hose from the fuel pressure regulator. 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON with a scan tool. 5. Inspect for a fuel leak from the fuel pressure regulator atmospheric vent. Is the fuel pressure regulator leaking fuel?		Go to **Step 20**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** .			

8	3. Disconnect the fuel feed hose and the fuel return hose from the fuel rail pipes. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** . 4. Install the **J 37287** Fuel Line Shut-off Adapters between the fuel hoses and the fuel rail pipes. 5. Open the valves on the fuel pipe shut-off adapters. 6. Turn ON the ignition, with the engine OFF. 7. Command the fuel pump relay ON with a scan tool. 8. Bleed the air from the fuel pressure gage. 9. Command the fuel pump relay ON and then OFF with a scan tool. 10. Close the fuel feed pipe shut-off valve. 11. Monitor the fuel pressure gage for 1 minute. Does the fuel pressure remain constant?	-	Go to **Step 9**	Go to **Step 17**
9	1. Turn OFF the ignition. 2. Open the fuel feed pipe shut-off valve. 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON and then OFF with a scan tool. 5. Close the fuel return pipe shut-off valve. 6. Monitor the fuel pressure gage for 1 minute. Does the fuel pressure remain constant?	-	Go to **Step 20**	Go to **Step 18**
10	Is the fuel pressure more than the specified value?	395 kPa (57 psi)	Go to **Step 12**	Go to **Step 11**
11	Is the fuel pressure more than the specified value?	0 kPa (0 psi)	Go to **Step 14**	Go to **Step 15**
	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Disconnect the fuel return hose from the fuel rail return pipe. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .			

12	4. Attach a length of flexible hose to the fuel rail return pipe. 5. Place the open end of the flexible fuel hose into an approved gasoline container. 6. Turn ON the ignition, with the engine OFF. 7. Monitor the fuel pressure gage while the fuel pump is operating. Is the fuel pressure within the specified range?	345-395 kPa (50-57 psi)	Go to **Step 19**	Go to **Step 13**
13	Inspect the fuel rail outlet passage and the fuel rail return pipe for a restriction. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
14	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Disconnect the fuel return hose from the fuel rail return pipe. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** . 4. Install the **J 37287** Fuel Line Shut-off Adapter between the fuel return pipe and the fuel rail. 5. Open the valve in the fuel pipe shut-off adapter. 6. Turn ON the ignition, with the engine OFF. 7. Bleed the air from the fuel pressure gage. 8. Monitor the fuel pressure gage. **NOTE:** **DO NOT allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel system.** 9. Command the fuel pump relay ON with a scan tool. 10. Slowly close the valve in the fuel return pipe shut-off adapter, while the fuel pump is operating. Does the fuel pressure increase to more than the specified value?	395 kPa (57 psi)	Go to **Step 20**	Go to **Step 15**
	Inspect the following components for a restriction:			

15	• The fuel filter • The fuel feed pipe Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 16**
16	Inspect the harness connectors and the ground circuits of the fuel pump for poor connections. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 17**
17	1. Remove the fuel sender assembly. Refer to **Fuel Sender Assembly Replacement** . 2. Inspect the following items: • The fuel pump flex hose for damage • The in-tank fuel pump harness connectors for poor connections • The fuel strainer for a restriction • The fuel tank for contaminants Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 21**
18	1. Turn OFF the ignition. 2. Raise the fuel rail with the fuel pipes connected. Refer to **Fuel Rail Assembly Replacement** . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON with a scan tool. 5. Locate and replace the leaking fuel injector. Refer to **Fuel Injector Replacement** . Did you complete the replacement.	-	Go to **Step 22**	
19	Repair the restricted fuel return pipe. Did you complete the repair?	-	Go to **Step 22**	-
20	**IMPORTANT:** **Inspect for a missing or damaged O-ring seal before replacing the fuel pressure regulator.** Replace the fuel pressure regulator. Refer to **Fuel Pressure Regulator Replacement** .Did you complete the replacement?	-	Go to **Step 22**	-

21	Replace the fuel sender. Refer to **Fuel Sender Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
22	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: 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 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**
	1. Disconnect the multi-way harness connector of the fuel injectors. 2. Measure the resistance of each fuel injector between the ignition 1 circuit and the fuel injector control circuit, at the		Go to **Fuel Injector**	

3	multi-way connector with a DMM. Refer to **Testing for Continuity** in Wiring Systems. Is the resistance within the specified range for each injector?	11-14 ohm	**Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2**	Go to **Step 6**
4	1. Disconnect the multi-way harness connector of the fuel injectors. 2. Measure the resistance of each fuel injector between the ignition 1 voltage circuit and the fuel injector control circuit, at the multi-way connector with a DMM. Refer to **Testing for Continuity** in Wiring Systems. 3. Record each fuel injector 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. Refer to **Fuel Injector Replacement** . 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. Refer to **Fuel Injector Replacement** . 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**	-
	IMPORTANT: **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.**			

4	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. Is the fuel pressure within the specified range?	345-395 kPa (50-57 psi)	Go to **Step 5**	Go to **Fuel System Diagnosis**
5	**IMPORTANT:** **The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.** Monitor the 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 6**
	NOTE: **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** 1. Disconnect the multi-way harness connector of the fuel injectors. 2. Connect the **J 39021** Fuel Injector Tester to the ignition 1 voltage circuit terminal and the appropriate fuel injector control circuit terminal using the **J 35616** Connector Test Adapter Kit. Refer to **Inline Harness Connector End Views** in Wiring Systems.			

6	3. Set the amperage supply selector switch on the fuel injector tester to the Balance Test 0.5-2.5 amp position. 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 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 2-7 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?	20 kPa (3 psi)	Go to **Step 7**	Go to **Symptoms - Engine Controls**
7	Perform the **Fuel Injector Cleaning Procedure** . Did you complete the procedure?	-	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-		Go to **Symptoms - Engine**

			System OK	**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**	-
	IMPORTANT: **Verify that adequate fuel is in the fuel tank**			

4	**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. Is the fuel pressure within the specified value?	345-395 kPa (50-57 psi)	Go to **Step 5**	Go to **Fuel System Diagnosis**
5	**IMPORTANT:** **The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.** Monitor the 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 6**
	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**			

6	**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 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?	20 kPa (3 psi)	Go to **Step 7**	Go to **Symptoms - Engine Controls**
7	Perform the **Fuel Injector Cleaning Procedure** . Did you complete the procedure?	-	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

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

- A short to battery voltage or ignition 1 voltage on the MAP sensor signal circuit will disable the injector control circuits.
- Monitoring the fuel injector circuit status with a scan tool, while moving the fuel injector harness, may help isolate an intermittent condition.
- Performing the Fuel Injector Coil Test may help isolate an intermittent condition. Refer to **Fuel Injector Coil Test** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Fuel Injector 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 P0201, P0202, P0203, P0204, P0205, or P0206 set?	Go to **DTC P0201-P0206**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the multi-way harness connector of the fuel injectors. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the fuel injector, fuse side, with a test lamp 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 6**
4	Test for continuity between the ignition 1 voltage circuit terminal and a fuel injector terminal, at the multi-way harness connector, fuel injector side. Refer to **Testing for Continuity** in Wiring Systems. Does the DMM display OL?	Go to **Step 7**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the multi-way harness connector. Refer to **Connector Repairs** and **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to Diagnostic Aids
6	Repair the open in the ignition 1 voltage circuit between the PCM 1 fuse and the multi-way connector. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-

7	Repair the open or high resistance in the ignition 1 voltage circuit of the fuel injectors between the multi-way connector and the splice. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	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**

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**
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**
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** Evaporative Emissions System Tester (EEST) and the **J 41415-40** Fuel Tank Cap Adapter or the GE-41415-50 Interrupted Thread 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** 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, the fill limiter vent valve, the pressure relief valve, and the grade vent valves-Refer to **Fuel Tank Replacement** . • The fuel sender housing and fuel sender seal-Refer to **Fuel Sender Assembly Replacement** .		

	• The fuel tank pressure (FTP) sensor seal-Refer to **Fuel Tank Pressure Sensor Replacement** . • The EVAP pipes-Refer to **Evaporative Emission (EVAP) Hoses/Pipes Replacement - Canister/Fuel Tank (Vapor Pipe)** **Evaporative Emission (EVAP) Hoses/Pipes Replacement - Canister/Fuel Tank (Vent Pipe)** . • The fuel fill pipe and hose-Refer to **Fuel Filler Hose 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. Refer to **Fuel Hoses/Pipes Replacement - Filter to Tank** . 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 J 44175-3 Instruction Manual.
2. If water appears in the fuel sample, perform the following steps:
   A. Clean the fuel system. Refer to **Fuel System Cleaning** .
   B. Replace the fuel filter. Refer to **Fuel Filter Replacement** .

3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample. Refer to the examples in the Fuel Composition Test Examples table.
4. If the fuel sample contains more than 15 percent ethanol, add fresh, regular gasoline to the vehicle's fuel tank.
5. Test the fuel composition.
6. If testing shows the ethanol percentage is still more than 15 percent, replace the fuel in the vehicle. Refer to **Fuel System Cleaning** .

Fuel Composition Test Examples

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

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

Circuit Description

The electronic ignition system uses an individual ignition coil for each cylinder. The powertrain control module (PCM) controls the ignition operation through six ignition control (IC) circuits. Each ignition coil is connected to the PCM, power, or ground by the following circuits:

- The ground
- The ignition 1 voltage
- The appropriate IC control circuit

The PCM triggers an ignition coil by grounding the appropriate IC control circuit using information from the crankshaft position (CKP) and camshaft position (CMP) sensors.

Diagnostic Aids

- The crankshaft position (CKP) signal is not needed to start and run.
- Many situations may lead to an intermittent condition. Perform each inspection or test as directed.

IMPORTANT: Remove any debris from the connector surfaces before servicing a component. Ensure that the gaskets are installed correctly. The gaskets prevent contaminate intrusion.

- Inspect the PCM and the engine grounds for clean and secure connections. Refer to **Wiring Repairs** in Wiring Systems.
- For intermittent conditions, refer to **Intermittent Conditions** .

Test Description

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

5: A few sparks, then nothing is considered no spark.

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	Are DTCs P0335 or P0336 set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Attempt to start the engine. Does the engine start and run?	-	Go to **Step 4**	Go to **Step 15**
4	Observe the Misfire Current Counters parameter with a scan tool. Does the scan tool display any Misfire Current Counters incrementing?	-	Go to **Step 5**	Go to Diagnostic Aids
5	1. Remove the ignition coil for the affected cylinder. Refer to **Ignition Coil(s) Replacement** . 2. Install the **J 26792** Spark Tester to the spark plug boot. 3. Attach the clamp end of the **J 26792** to a good engine ground. 4. Observe the **J 26792** . 5. Crank the engine. Does spark jump the tester gap?	-	Go to **Step 11**	Go to **Step 6**
	1. Turn OFF the ignition. 2. Disconnect the ignition coil for the misfiring cylinder. 3. Turn ON the ignition, with the engine OFF. 4. Measure the battery voltage with a DMM. 5. Connect a test lamp between the ignition 1 voltage circuit at the harness connector of			

6	the affected ignition coil and a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. 6. Measure the voltage from the ignition 1 voltage circuit to a good ground with a DMM. Refer to **Measuring Voltage Drop** in Wiring Systems. Is the voltage within 0.50 volt of the specified value?	B+	Go to **Step 7**	Go to **Step 15**
7	Probe the ignition 1 voltage circuit of the affected ignition coil with a test lamp connected to the ignition coil ground circuit. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 16**
8	1. Start the engine. 2. Measure the DC frequency from the IC control circuit of the respective ignition coil to a good ground. Does the frequency measure within the specified range?	2-20 Hz	Go to **Step 14**	Go to **Step 9**
9	1. Turn ON the ignition, with engine OFF. 2. Measure the voltage from the IC control circuit of the respective ignition coil to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the voltage measure more than the specified value?	1 V	Go to **Step 17**	Go to **Step 10**
10	Test the IC control circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 13**
11	1. Exchange the spark plug with a spark plug from a non-misfiring cylinder. Refer to **Spark Plug Replacement** . 2. Install the ignition coil.	-		

	3. Start the engine. Does the scan tool display that the misfire followed that spark plug?		Go to **Step 20**	Go to **Step 12**
12	Inspect the insulating spark plug boot and conducting spring for the following conditions: • Any contamination • Any deterioration • Any arching Did you find and correct the condition?	-	Go to **Step 21**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical
13	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 21**	Go to **Step 19**
14	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 21**	Go to **Step 18**
15	Repair the open, high resistance, or short to ground in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 21**	-
16	Repair the open in the ignition coil ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?		Go to **Step 21**	-
17	Repair the short to voltage in the IC control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 21**	-
18	Replace the ignition coil. Refer to **Ignition Coil (s) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the spark plug. Refer to **Spark Plug Replacement** .	-		

	Did you complete the replacement?		Go to **Step 21**	-
21	Attempt to start the engine. Does the engine start and run?	-	Go to **Step 22**	Go to **Step 2**
22	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Let the engine reach operating temperature. 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 heated oxygen sensor (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 failure indication 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 this 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.

Inspection/Maintenance (I/M) System Check

Step	Action	Yes	No
1	1. Perform the **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. Was a reprogramming or repair service required?	Go to **Inspection/Maintenance (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 that has not updated to YES

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.

Conditions for Running

Cold Start

- The barometric pressure (BARO) is more than 74 kPa.
- The engine coolant temperature (ECT) is below 30°C (86°F).
- The intake air temperature (IAT) is below 30°C (86°F).
- The difference between the intake air temperature (IAT) and the engine coolant temperature (ECT) is 8°C (14°F) or less.
- The battery voltage is between 9-18 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 tests can be performed using the individual System Set Procedures.

If the vehicle has recently run, start this procedure at step 3. This will allow the tests that require the engine at operating temperature to run. Using this method allows shorter cool down periods if the tests requiring a cold start do not initiate.

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.

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 that 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 that the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 6. Start the engine and allow the engine to idle. 7. Allow the engine to idle for the	2 minutes		

	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 8-10 minutes depending on the start up coolant temperature. 2. Continued 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. Vehicle speed reduced to 72 km/h (45 mph) with this speed maintained for one additional minute. 2. Four decelerations of 25 seconds each from 72 km/h (45 mph) while the following criteria is maintained: • The throttle is closed. • NO brake application on either manual or automatic transmission • NO clutch actuation on a manual transmission • NO manual downshift • The vehicle speed remains	-		

	above 40 km/h (25 mph). • After each deceleration period, the vehicle is returned to 72 km/h (45 mph) under part throttle acceleration and the speed is maintained for 15 seconds. Is the action complete?		Go to**Step 5**	-
5	**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 (47-55 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 • Manual transmission in neutral with the clutch pedal depressed Is the action complete?	-	Go to**Step 6**	-
6	Observe the I/M System Status display, with a scan tool. Did all of the I/M System Status indicators update to YES?	-	Go to **Step 7**	Go to the I/M System Set Procedure for the indicated systems that did not update to YES
7	Observe the Emission Related DTC portion of the I/M System Status display, with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	-	Go to **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
AIR	**DTC P0410**
Catalyst	**DTC P0420**
Evaporative Emission (EVAP)	**DTC P0442** **DTC P0446** **DTC P0496**
Oxygen Sensor	**DTC P0130** **DTC P0131** **DTC P0132** **DTC P0133** **DTC P0134** **DTC P0137** **DTC P0138** **DTC P0140** **DTC P1133** **DTC P1137** **DTC P1138**
Oxygen Sensor Heater	**DTC P0135 or P0141**

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

Description

The purpose of this test is to satisfy the enable criteria necessary to execute I/M readiness diagnostics for the secondary air injection (AIR) system. The test may be used to set the I/M System Status to YES.

Conditions for Running

Passive Test

- The engine coolant temperature (ECT) is between 70-110°C (158-230°F).
- The intake air temperature (IAT) is between 2-100°C (36-212°F).
- The battery voltage is more than 11.7 volts.
- The Active Test, if required, begins after the engine goes into Closed Loop fuel control.

Active Test

- The ECT is between 70-110°C (158-230°F).
- The IAT is more than 2°C (36°F).
- The engine is operating in Closed Loop fuel control.
- The battery voltage is more than 11.7 volts.

Diagnostic Aids

The AIR pump generally operates once per ignition cycle, usually upon initial start up before the engine goes

into Closed Loop fuel control. Some systems will perform a Passive Diagnostic Test at this time. The Active Diagnostic Test is performed after the engine goes into Closed Loop fuel control. On vehicles that perform a Passive Test, the Active Test will only run if the Passive Test fails or is indeterminate. The Active Test may not run if the Passive Test passes.

If the diagnostic test does not run, observe the fuel trim correction. If the fuel trim correction is more than plus or minus 4 percent, the AIR System Test may not run. 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.

Inspection/Maintenance (I/M) AIR 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 that 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 for 2 minutes. **CAUTION:**		

2	**Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:** **In order for the Active 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 for 3 minutes or until the I/M System Status indicator updates to YES. 5. Review the I/M System Status display, with a scan tool. Did the AIR 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. 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 AIR 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) 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.

Conditions for Running

- The barometric pressure (BARO) is more than 74 kPa.
- The engine coolant is at operating temperature, 71-120°C (160-248°F).
- The intake air temperature (IAT) is between -15 to +75°C (+5 to +167°F).
- The engine is in Closed Loop fuel control.
- The engine has run for 6-8 minutes off idle in order to initiate test.
- The battery voltage is between 11-18 volts.

Diagnostic Aids

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

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.

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 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 • 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**
	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	4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display, with a scan tool. Did the Catalyst System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display, with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to **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.

Conditions for Running

Non Scan Tool Service Bay Test Equipped Vehicles

- The barometric pressure is more than 75 kPa.
- The fuel level is between 1/4 and 3/4.
- The battery voltage is between 10-18 volts.
- The test will initiate only after a cold start. The control module considers the engine to be cold if the following conditions are met:
  - The engine coolant temperature (ECT) is between 3.75-30°C (39-86°F).
  - The intake air temperature (IAT) is between 3.75-30°C (39-86°F).
  - The difference between the ECT and the IAT is less than 8°C (14°F).

Scan Tool Service Bay Test Equipped Vehicles

- The barometric pressure (BARO) is more than 75 kPa.

- The ECT is less than 80°C (176°F).
- The fuel level is between 1/4 and 3/4.
- The battery voltage is between 10-18 volts.

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 Service Bay Test may prevent having to repeat the test. A loose fuel cap may cause a Service Bay 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.

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

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
2	1. Select Special Functions with a scan tool. 2. Determine if the vehicle is equipped with a Service Bay Test for the EVAP System. Is the vehicle equipped with EVAP Service Bay Test?	Go to **Step 3**	Go to **Step 5**

3	1. Ensure that 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. Following the directions on the scan tool, perform the EVAP Service Bay Test. Did the EVAP System pass the Service Bay Test?	Go to **Step 8**	Go to **Step 4**
4	1. Observe the scan tool Service Bay Test for an indication of why the test did not pass, e.g., failed DTC, test aborted, etc. 2. Refer to the appropriate service information for diagnosis and repair of the condition as necessary. Is the repair complete?	-	Go to **Inspection/Maintenance (I/M) Complete System Set Procedure**
5	1. Ensure that 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. **IMPORTANT:** **Once the engine is started, DO NOT turn the engine OFF for the remainder of the procedure until the test is complete.** 3. Start the engine and idle. **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 km/h (45 mph) with this speed maintained until the engine reaches operating temperature. This may be up to 8-10 minutes depending on the start up coolant temperature. 5. Continue the operating conditions for an		

	additional 3 minutes after the engine reaches operating temperature, or until the I/M System Status indicator updates to YES. Did the EVAP System Status update to YES?	Go to **Step 8**	Go to **Step 6**
6	Observe the DTC Information, with a scan tool. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 7**
7	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. 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 8**	Go to Diagnostic Aids
8	Observe the Emission Related DTC portion of the I/M System Status display, with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to **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 (O2S, HO2S) system. The test may be used to set the I/M System Status to YES.

Conditions for Running

- The engine coolant temperature (ECT) is more than 57°C (135°F).
- The engine is running in Closed Loop fuel control.
- The engine has been running for more than 160 seconds.
- The battery voltage is between 9-18 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.

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

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
	1. Ensure that the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle.		

2	**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 75-90 km/h (47-56 mph) with this speed maintained for 6 minutes or until the I/M System Status updates to YES. Manual transmissions, either 5 or 6 speed, may require operation in 4th or 5th gear respectively, in order for this test to run. 5. Review the I/M System Status display, with a scan tool. Did the HO2S/O2S System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	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 **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display, with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display, with a scan tool.		

	Did the 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) system. The test may be used to set the I/M System Status to YES.

Conditions for Running

- The start-up engine coolant temperature (ECT) is less than 50°C (122°F).
- The start-up intake air temperature (IAT) is less than 50°C (122°F).
- The difference between the IAT and the ECT is less than 8°C (14°F).
- The battery voltage is between 11-18 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 Test from initiating.

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.

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**
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.** 1. Preprogram the scan tool with the vehicle information before the ignition is turned ON. 2. Ensure that the vehicle is within the Conditions for Running specified in the supporting text. 3. Set the vehicle parking brake. 4. Verify that 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. 7. 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. 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