
ENGINE PERFORMANCE

Engine Controls and Fuel - 6.2L (LT1) - Diagnostic Information and Procedures - Corvette

DIAGNOSTIC INFORMATION AND PROCEDURES

MALFUNCTION INDICATOR LAMP (MIL) DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the engine control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the ignition is ON and the engine is OFF.

Diagnostic Aids

If the condition is intermittent, move the related harnesses and connectors while monitoring the scan tool MIL control circuit status parameters. Perform this test with the ignition ON and the engine OFF and with the engine running. The MIL control circuit status parameters change from OK or Not Run to Fault if there is a condition with a circuit or a connection.

Reference Information

Schematic Reference

- **Engine Controls Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Any MIL requesting DTCs that may be set should be diagnosed first.**

1. Ignition ON.
2. Verify the parameters listed below do not display Malfunction when commanding the malfunction indicator lamp ON and OFF with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**
3. Engine running.
 4. Verify the parameters listed below do not display Malfunction when commanding the malfunction indicator lamp ON and OFF with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**
5. Verify the malfunction indicator lamp turns ON and OFF when commanding the malfunction indicator lamp ON and OFF with a scan tool.
 - **If the malfunction indicator lamp does not turn ON and OFF**

Refer to Circuit/System Testing

- **If the malfunction indicator lamp turns ON and OFF**
6. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the X1 harness connector at the K20 Engine Control Module.

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3. Ignition ON, verify the malfunction indicator lamp does not illuminate.
 - **If the malfunction indicator lamp illuminates**
 1. Test for infinite resistance between the malfunction indicator lamp control circuit terminal X1 46 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.
 - **If the malfunction indicator lamp does not illuminate**
 4. Connect a 3 A fused jumper wire between the malfunction indicator lamp control circuit terminal X1 46 and ground.
 5. Verify the malfunction indicator lamp illuminates.
 - **If the malfunction indicator lamp illuminates**

Replace the K20 Engine Control Module.
 - **If the malfunction indicator lamp does not illuminate**
 1. Test for less than 1 V between the malfunction indicator lamp control circuit terminal X1 46 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 2. Ignition OFF.
 3. Test for less than 2 ohms in the malfunction indicator lamp control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms.
 6. Ignition OFF, disconnect the harness connector at the instrument cluster.
 7. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 8 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ignition voltage circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - **If the test lamp illuminates**
 8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

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- **Instrument Cluster Replacement**
 - **Control Module References** for replacement, programming and setup.

ENGINE CRANKS BUT DOES NOT RUN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

This Engine Cranks but Does Not Run diagnostic is an organized approach to identify a condition which causes the engine to crank but does not continue to run. This diagnostic directs the service technician to the appropriate system diagnosis. This diagnostic assumes the vehicle system voltage levels are adequate for starter motor operation. Refer to **Battery Inspection/Test** and **Engine Cranks Slowly**. The fuel level supply must be adequate and the fuel quality must be able to sustain the combustion process.

Diagnostic Aids

Inspect for any of the following conditions:

- Insufficient fuel can cause a no start condition. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles or a malfunctioning solenoid, can cause a no start condition.
- There may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the fuel injectors and the injector circuit are OK and fuel spray is detected, the fuel injector ON time may be inadequate. If the engine control module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Observe all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.
- Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200-300 RPM while cranking. If erratic values such as sudden spikes in the engine speed are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
- Inspect the engine for good secure electrical grounds.
- If the engine almost starts and then stalls, inspect for an open in the ground circuits of the CKP sensor and the camshaft position (CMP) sensor.
- Water or foreign material in the fuel can cause a no start or engine will not stay running condition. During freezing weather water can freeze inside the fuel system. The engine may

start after 30 minutes in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.

- A vehicle that starts and runs after being brought to the repair shop for a no start condition may have an ignition system that is susceptible to moisture. Spray water on the ignition system components and the wiring in order to verify for an engine starting or will not stay running concern.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 26792 HEI Spark Tester

Circuit/System Verification

NOTE: This diagnostic assumes the following:

- The battery is completely charged.
- The engine cranking speed is acceptable.
- There is adequate fuel in the fuel tank.

1. Crank the engine for up to 15 seconds.
2. Verify DTC P0117, P0118, P0122, P0123, P0201-P0208, P0222, P0223, P0300-P0308, P0335, P0336, P0351-P0358, P0562, P0563, P0601-P0604, P0606, P0607, P062F, P0633, P0685, P0690, P1631, P1682 or P2610 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Ignition ON.
4. Verify the security indicator on the instrument cluster illuminates momentarily.
 - **If the indicator stays illuminated or is flashing**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If the indicator does not stay illuminated and is not flashing**

5. Verify the scan tool Engine Speed parameter is greater than 0 RPM while cranking the engine.
 - **If 0 RPM**

Refer to **DTC P0335 or P0336** for further diagnosis.

- **If greater than 0 RPM**

6. Connect the **EL 26792** HEI spark tester between the boot of a spark plug wire and ground.

NOTE:

- **Perform the spark test on at least one cylinder for each cylinder bank.**
- **An erratic or weak spark is considered a no spark condition.**

7. Verify the spark tester sparks while cranking the engine.
 - **If the spark tester does not spark**

Refer to **Electronic Ignition System Diagnosis**.

- **If the spark tester sparks**

8. Ignition ON.
9. Command the Fuel Pump Enable ON several times with a scan tool.

NOTE: If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Do not attempt to record fuel pressure readings until the engine coolant temperature is below 60° C (150° F).

10. Verify the scan tool Fuel Pressure Sensor parameter is between 320-580 kPa (46-84 psi) with

- If not within the specified range

Refer to **Fuel System Diagnosis**.

- If within the specified range

NOTE: The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant.

11. Verify that the fuel pressure decreases to 468-544 kPa (68-79 psi) after the pump has turned OFF and does not decrease greater than 34 kPa (5 psi) in 1 minute.

- If not within the specified range

Refer to **Fuel System Diagnosis**.

- If within the specified range

12. Verify the following conditions do not exist:

- Collapsed air intake duct to the throttle body
- Restricted air filter element
- Spark plugs for being fouled
- A skewed manifold absolute pressure (MAP) sensor-Refer to **DTC P0106** .
- A skewed engine coolant temperature (ECT) sensor-Refer to **DTC P0116** .
- Exhaust system restricted-Refer to **Restricted Exhaust** .
- Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis**.
- Engine mechanical condition, such as worn timing chain and gears or low compression-Refer to **Symptoms - Engine Mechanical** or **Engine Compression Test** .

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Problem	Causes
DEFINITION: During the fueling process a continual, occasional or no-fuel nozzle shut-off condition has occurred.	
Difficult to fill	• Fuel fill limiter vent valve stuck closed • Evaporative emission (EVAP) canister restricted • EVAP vent valve stuck closed • Hose between canister and canister vent solenoid twisted

	• or kinked if applicable • High fuel temperature • Fuel filler hose is kinked • Faulty dispensing nozzle • Ignition switch ON, vent valve closed
Over fill	• Fill limiter vent valve stuck open or leaking • Fuel inlet check valve stuck open
Pre-mature shut-off of the fuel dispensing nozzle occurs immediately after engaging dispensing nozzle, tank empty	• Restricted vapor lines or fuel fill pipe • High fuel temperature • Inlet check valve at tank stuck closed, fill pipe full of fuel • Fuel tank full, gauge not accurate
Pre-mature shut-off of the fuel dispensing nozzle, more than 1/8 of tank capacity dispensed	• Kinked, pinched or plugged lines in fuel tank vent system • EVAP vent valve stuck closed or restricted • EVAP canister restricted • Fuel limiting vent valve stuck closed or obstruction at top of fuel tank
Fuel Spitback	• Restricted EVAP canister • High fuel temperature • Ignition switch ON, EVAP vent valve closed

FUEL INJECTOR DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies a separate high voltage supply circuit and a high voltage control circuit for each fuel injector. The ECM initially opens each fuel injector with 65 V. This high voltage is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through a fuel injector, allowing for initial fuel injector opening. The fuel injector is then held open with 12 V. The ECM varies the amount of time each fuel injector is open to provide proper combustion under all engine load conditions.

A fuel injector coil winding resistance that is too high or too low will affect the engine driveability. 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.

Schematic Reference

Engine Controls Schematics

Electrical Information Reference

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

Component Testing

NOTE:

- The resistance test must be performed at the fuel injector or mis-diagnosis will occur.
- The DMM and test leads must be calibrated to 0 ohms in order to prevent mis-diagnosis.

1. Test for 1.06 ohms $\pm$ 10% @ 20°C (68°F) between the high voltage supply circuit terminal 2 and the high voltage control circuit terminal 1 at the Q17 Fuel Injector.

- **If not within the specified range**

Replace the Q17 Fuel Injector.

- **If within the specified range**

2. Test for infinite resistance between each terminal at the Q17 Fuel Injector and the Q17 Fuel Injector housing/case.

- **If not infinite resistance**

Replace the Q17 Fuel Injector.

- **If infinite resistance**

3. All OK, perform the **Fuel Injector Balance Test**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Fuel Injector Replacement

FUEL SYSTEM DIAGNOSIS

Diagnostic Instructions

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- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
 - **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is ON. The voltage from the ECM to the fuel pump driver control module remains active for 2 s, unless the engine is in Crank or Run. While this voltage is being received, the fuel pump driver control module closes the ground switch of the fuel tank fuel pump module and also supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure.

The fuel system is an electronic returnless on-demand design. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

An electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank. The fuel pump supplies fuel through the fuel feed pipe to the high pressure fuel pump. The high pressure fuel pump supplies fuel to a variable-pressure fuel rail. Fuel enters the combustion chamber through precision multi-hole fuel injectors. The high pressure fuel pump, fuel rail pressure, fuel injection timing and injection duration are controlled by the ECM.

Diagnostic Aids

Observe the Misfire Counters or perform the Fuel Injector Balance Test to help identify a leaking Fuel Injector. Refer to **Fuel Injector Balance Test**.

Reference Information

Description and Operation

Fuel System Description

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J 37287 Fuel Line Shut-Off Adapter

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

NOTE:

- Repair all fuel system related DTCs before performing this diagnostic.
- Inspect the fuel system for damage or external leaks before proceeding.
- Verify that adequate fuel is in the fuel tank before proceeding.
- The Fuel Pump Enable may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.
- DO NOT perform the Fuel System Diagnosis if the engine coolant temperature is above 60°C (150°F). High fuel pressure readings may result due to hot soak fuel boiling. With the engine OFF, the fuel pressure may increase beyond the pressure relief regulator valve's setting point of 690 kPa (100 psi) $\pm$ 5 percent.

1. Ignition ON, engine OFF, command the Fuel Pump Enable ON several times with a scan tool.
2. Verify the scan tool Fuel Pressure Sensor parameter is between 320-608 kPa (46-88 psi) with the fuel pump running.

- If less than 320 kPa (46 psi)

Refer to Circuit/System Testing - Fuel Pressure Low.

- If greater than 690 kPa (100 psi)

Replace the G12 Fuel Pump.

- If between 320-608 kPa (46-88 psi)

NOTE: 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.

3. Verify that the fuel pressure decreases to 468-544 kPa (68-79 psi) after the fuel pump is turned off.

- If the fuel pressure does not decrease to 468-544 kPa (68-79 psi)

Replace the G12 Fuel Pump.

- If the fuel pressure decreases to 468-544 kPa (68-79 psi)

4. Verify that the fuel pressure does not decrease greater than 34 kPa (5 psi) in 1 minute.

- If the fuel pressure decreases greater than 34 kPa (5 psi)

Refer to Circuit/System Testing - Fuel Pressure Leaks Down.

- **If the fuel pressure does not decrease greater than 34 kPa (5 psi)**
- 5. Relieve the fuel pressure to 69 kPa (10 psi), refer to **Fuel Pressure Relief** .
- 6. Verify that the fuel pressure does not decrease greater than 14 kPa (2 psi) in 5 minutes.
 - **If the fuel pressure decreases greater than 14 kPa (2 psi)**

Replace the G12 Fuel Pump.

- **If the fuel pressure does not decrease greater than 14 kPa (2 psi)**

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

- 7. Operate the vehicle within the conditions of the customer's concern while monitoring the Fuel Pressure Sensor parameter with a scan tool.
- 8. Verify the fuel pressure does not drop off during acceleration, cruise or hard cornering.
 - **If the fuel pressure drops off**

Refer to Circuit/System Testing - Fuel Pressure Drops OFF.

- **If the fuel pressure does not drop off**
- 9. If the fuel system components test normal, refer to **Symptoms - Engine Controls** , **Fuel Injector Diagnosis** and **Fuel Injector Balance Test** for further diagnosis.

Circuit/System Testing

Fuel Pressure Low

- 1. Verify none of the conditions listed below exist:
 - Restricted fuel feed pipe
 - Restricted or plugged strainer
 - Poor connections at the fuel pump harness connector and the ground circuits.
- **If a condition exist**

Repair as necessary.

- **If a condition does not exist**
- 2. Test or replace the G12 Fuel Pump.

Fuel Pressure Leaks Down

1. Ignition OFF, relieve the fuel pressure. Refer to **Fuel Pressure Relief** .
2. Install the **J 37287** Fuel Line Shut-Off Adapters between the fuel feed pipe and the fuel rail.
3. Open the valve on the **J 37287** Fuel Line Shut-Off Adapters.
4. Ignition ON, command the Fuel Pump Enable ON with a scan tool.
5. Close the valve on the **J 37287** Fuel Line Shut-Off Adapters.
6. Verify that the Fuel Rail Fuel Pressure parameter does not decrease greater than 34 kPa (5 psi) in 1 minute.

- **If the fuel pressure drops**

Locate and replace the leaking Q17 Fuel Injector.

- **If the fuel pressure does not drop**

7. Test or replace the G12 Fuel Pump.

Fuel Pressure Drops OFF

1. Verify none of the conditions listed below exist:
 - Restricted fuel feed pipe
 - Restricted or plugged strainer
 - Poor connections at the Fuel Pump harness connector and the ground circuit.
- **If a condition exist**

Repair as necessary.

- **If a condition does not exist**

2. Test or replace the G12 Fuel Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuel Feed Pipe Replacement**
- **Fuel Injector Replacement**
- **Fuel Feed Intermediate Pipe Replacement - Position 1**
- **Fuel Feed Intermediate Pipe Replacement - Position 2**
- **Fuel Tank Fuel Pump Module Replacement** for G12 Fuel Pump replacement.

FUEL INJECTOR BALANCE TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The fuel injector balance test is performed while the engine is running at idle. The scan tool pressurizes the fuel rail to a predetermined pressure before each fuel injector is pulsed for a precise amount of time allowing a measured amount of the fuel to be injected. This causes a drop in the system fuel pressure that is recorded and used to compare each fuel injector.

Diagnostic Aids

- Monitoring the Current Misfire Counters 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.

Circuit/System Verification

NOTE:

- **DO NOT perform this test if the engine coolant temperature (ECT) is above 60°C (140°F). Irregular fuel pressure readings may result due to hot soak fuel boiling.**
- **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.**

1. Ignition ON.
2. Command the Fuel Pump Enable ON with a scan tool.
3. Verify the fuel pressure is between 320-580 kPa (46-84 psi) with the fuel pump running.
 - **If not within 320-580 kPa (46-84 psi)**

Refer to **Fuel System Diagnosis**

- **If within 320-580 kPa (46-84 psi)**

NOTE: 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.

4. Verify the fuel pressure does not decrease greater than 34 kPa (5 psi) within 1 minute.
 - **If greater than the specified value**

Refer to **Fuel System Diagnosis**.

- **If less than the specified value**

5. Engine idling, Verify the Fuel Rail Pressure Sensor 1 parameter is between 1.9-5.0 MPa (276-

725 psi).

- **If not between 1.9-5.0 MPa (276-725 psi)**

Refer to **Fuel System Diagnosis**.

- **If between 1.9-5.0 MPa (276-725 psi)**

6. Perform the Circuit/System Testing - Fuel Injector Balance Test.

Circuit System Testing

Fuel Injector Balance Test

NOTE: The engine speed must be between 600-1000 RPM to perform this test.

1. Engine idling.
2. Select the Fuel Injector Balance function within the Output Controls menu of a scan tool.
3. Select and test a Q17 Fuel Injector. Repeat for each Q17 Fuel Injector.
4. Obtain and record a pressure drop value for each Q17 Fuel Injector.
5. Add all of the individual pressure drop values except for the fuel injector suspected of being faulty. This is the total pressure drop.
6. Divide the total pressure drop by the number of fuel injectors that were added together. This is the average pressure drop.
7. Multiply the average pressure drop by 0.20. This is the acceptable variance from the average pressure drop, 20%.
8. Verify the difference between any individual pressure drop and the average pressure drop is not greater than the acceptable variance.
 - **If greater than the acceptable variance**

Replace the Q17 Fuel Injector.

- **If within the acceptable variance**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Fuel Injector Replacement

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

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- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
 - **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System 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% in non-blended gasoline or greater than 85% with E85 blended gasoline for flexible fuel applications can cause 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.

Reference Information

Special Tools

CH 44175-A Alcohol Tester Kit

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Remove a sample of fuel from the bottom of the fuel tank and place in a clean, clear container.
2. Place the sample on a level surface for 2 minutes.
3. Verify the sample is clear and bright in color.
 - **If the sample appears cloudy or contaminated with water, as indicated by a water layer at the bottom of the sample**

Refer to Circuit/System Testing - Particulate Contaminants in Fuel.

- **If alcohol contamination is suspected**

Refer to Circuit/System Testing - Alcohol in Fuel Testing.

- **If the sample remains clear and bright**

4. All OK.

Circuit/System Testing

Alcohol in Fuel Testing with Special Tool

1. Test the fuel composition using **CH 44175-A** Alcohol Tester Kit and Instruction Manual.

- **If water appears in the fuel sample**

Clean the fuel system.

- **If no water appears in the fuel sample**

3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
4. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.
 - **If greater than the specified value**
 1. Add fresh regular gasoline to the vehicle's fuel tank.
 2. Remove a new sample of fuel from the tank.
 3. Test the fuel composition using **CH 44175-A** Alcohol Tester Kit and Instruction Manual.
 4. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
 5. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.
 - If additional testing indicates that the ethanol percentage is still above 15% for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to **Fuel Tank Draining**.
 - If additional testing indicates that the E85 blended gasoline sample still measures above 91%, continue adding fresh, regular gasoline until the ethanol content is 85% or less.
 - **If the specified value or less**
5. All OK.

Alcohol in Fuel Testing without Special Tool

NOTE: This procedure is for non-blended gasoline only. If excessive alcohol content is suspected with E85 fuel add 15% tank volume of fresh, regular gasoline to the fuel tank.

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% 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.

7. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
 - **If greater than the specified value**
 1. Add fresh regular gasoline to the vehicle's fuel tank.
 2. Remove a new sample of fuel from the tank.
 3. Test the fuel composition of the new sample.
 4. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
 - If greater than the specified value, drain and replace the vehicle's fuel. Refer to **Fuel Tank Draining**.
 - If the specified value or less, all OK.
 - **If the specified value or less**
8. All OK.

Particulate Contaminants in Fuel

1. Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel from the bottom of the fuel tank.
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. Verify there are no physical contaminants or water present in the fuel sample.
 - **If any physical contaminants or water are present**

Clean the fuel system.
 - **If no physical contaminants or water are present**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Fuel System Cleaning

ELECTRONIC IGNITION SYSTEM DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

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- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

This ignition system uses an individual ignition coil for each cylinder. The engine control module (ECM) controls the spark events by transmitting the timing pulses on the ignition control (IC) circuits to the individual ignition coil in firing order sequence.

Diagnostic Aids

- This engine application may use 2 fuses, one for each bank, to supply ignition voltage to the ignition module/coil assemblies and also to the fuel injectors. A good indication that a fuse is open is that all misfire counters are incrementing on one side of the engine.
- An open/high resistance on the low reference circuit to the ignition coil may cause a misfire.
- An erratic or weak spark is considered a no spark condition.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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Electronic Ignition System Description

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Special Tools

EL 26792 HEI Spark Tester

Circuit/System Verification

Verify the following conditions. Refer to **Spark Plug Wire Inspection** and **Ignition System Specifications** .

- The ignition coils and spark plug wires are correctly connected
- The spark plug wire resistance is within specifications
- The correct spark plug type
- The correct spark plug gap
- The correct spark plug torque

- **If a condition was found**

Repair or replace as necessary.

- **If a condition was not found**

Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Do not perform this diagnostic procedure unless you were sent here from a misfire DTC or the Engine Cranks But Does Not Run diagnostic.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 5 ohms**
3. Test for less than 5 ohms between the low reference circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
4. Ignition ON.

- **If the test lamp does not illuminate**

1. Ignition OFF.
2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp illuminates**

6. Ignition OFF, exchange the suspect T8 Ignition Coil with the T8 Ignition Coil of a known functioning cylinder.
7. Engine Running.
8. Verify the scan tool Ignition Coil Control Circuit Status parameter displays OK for the same cylinder that the suspect T8 Ignition Coil was removed from.

- **If OK is not displayed**

Replace the K20 Engine Control Module.

- **If OK is displayed**

Test or replace the T8 Ignition Coil.

Component Testing

NOTE: You must perform the Circuit/System Testing before proceeding with Component Testing.

1. Ignition OFF, connect the **EL 26792** HEI Spark Tester to the appropriate T8 Ignition Coil, engine Running.
2. Verify the spark output of the T8 Ignition Coil.
 - **If no output or the output is weak**

Replace the T8 Ignition Coil

- **If the output is good**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition Coil Replacement**
- **Spark Plug Replacement**
- **Spark Plug Wire Replacement**
- **Control Module References** for engine control module replacement, programming and setup.

EVAPORATIVE EMISSION SYSTEM DIAGNOSIS

Special Tools

EN 41413-VLV EVAP Service Port Vent Fitting

Operating Instructions for the Evaporative Emission System Tester (EEST)

Vehicle Setup

WARNING: Refer to Fuel and Evaporative Emission Pipe Warning .

CAUTION: Refer to Clean, Dry, Low Pressure Gas Source Caution .

NOTE: When servicing the EVAP system, test pressure must not exceed 13 in H2O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.

NOTE: A large difference between the vehicle temperature and shop temperature will seriously affect the accuracy of the tests. Always allow at least 15 min for the vehicle temperature to adjust to the shop temperature. Refer to Temperature Variation Instructions for more information about vehicle versus shop temperatures.

1. Engine OFF, open the hood. Position a large fan to blow air under the vehicle onto the fuel tank area.
2. Connect the red battery clip from the tester to the positive battery terminal.

NOTE: The vehicle battery must be fully charged for optimum tester performance.

3. Connect the black battery clip from the tester to chassis ground.

Flow Meter Test - Leak Detection

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

1. Open the Nitrogen tank valve and turn the NITROGEN/SMOKE valve on the front control panel to NITROGEN.
2. Connect the hose to the correct test orifice on the bottom front of the tester. For orifice size, refer to the vehicle specific information found in service procedures for DTCs that relate to

3. Press and release the remote switch to activate the tester.

NOTE: **The tester will time out after about 15 min. You may press the remote switch to reactivate the tester as desired.**

4. Position the sliding red flag on the flow meter to align with the floating indicator. When the red flag is set, press and release the remote switch to deactivate the tester.
5. Remove the hose from the test orifice and install the hose onto the vehicle. For proper connection location and the special tool numbers for any adapters that may be required, refer to the service procedures for DTCs that relate to EVAP system leaks.
6. Ignition ON, seal the EVAP system per instructions in the service procedures for DTCs that relate to EVAP system leaks. Most systems can be sealed using a scan tool output control for the EVAP Vent Solenoid Valve, other systems require that the vent system be plugged.

NOTE:

- **Larger volume fuel tanks, and/or those with lower fuel levels, may require several minutes to fill with nitrogen.**
- **Static buildup may cause the float indicator to stick. It may be necessary to tap on the flow meter to free up the float.**
- **If fuel level is 90 % or greater it will take longer to fill the system with smoke because the fuel fill tube check valve will be closed and force any smoke to pass through the ORVR pipe and orifice.**

7. Press and release the remote switch to activate the nitrogen flow and fill the system.
8. Compare the stable floating indicator position to the red flag.
 - Below the red flag, the result is acceptable, Pass. Test complete
 - Above the red flag, the result is unacceptable, Fail. Go to the Smoke Procedure
9. Press and release the remote switch to deactivate the tester.

Smoke Procedure - Locate the Leak

NOTE: **It is not recommended to use the tester in an outside repair bay area because wind and sunlight may affect temperature and your ability to see the smoke.**

1. Turn OFF any fans that may cause air movement around or near the vehicle.

NOTE: **Completely unwind the nitrogen/smoke hose from the bracket to optimize the tester's performance.**

2. Connect the nitrogen/smoke hose to the vehicle as directed in the service procedures. Some vehicles require that the nitrogen/smoke hose be connected at the front of the EVAP system at the EVAP service port. An adapter may be necessary. Other vehicles require the connection be made at the rear of the system using an adapter at the fuel fill cap. Consult the service

procedures for DTCs that relate to evaporative emission (EVAP) system leaks for vehicle specific instructions regarding connection location and adapters.

3. Open the Nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to smoke.

NOTE: **The remote switch operates on a push ON, push OFF fashion.**

4. Press and release the remote switch to activate the tester and inject smoke into the EVAP system.
5. Verify smoke has filled the EVAP system by opening the system opposite the end where smoke is injected. When injecting smoke at the service port, remove the fuel fill cap until smoke is observed. Then close the system and continue testing. If using a special tool fuel fill cap adapter at the filler neck, vent the system at the service port, with special tool EN 41413-VLV EVAP Service Port Vent Fitting, until smoke is observed then remove the vent fitting tool and close the system to continue with the test.

NOTE: **Inject smoke in less than 2 min cycles for optimum tester performance.**

6. Press and release the remote switch to deactivate the tester.

NOTE: **For optimum visual smoke performance, deactivate the smoke flow and allow the system pressure to drop. Allowing the smoke to exit small holes at a low flow rate greatly enhances visibility.**

7. Introduce smoke into the system for an additional 60 s. Continue introducing smoke at 15 s intervals, as necessary.
8. Using a high-intensity white light, inspect the entire EVAP system path and look for the source of the leak indicated by the exiting smoke. Introduce smoke at 15 s intervals, as needed, until leak source is identified.

Temperature Variation Instructions

The Concern

Ideal circumstances for conducting the EVAP flow meter test require equal temperatures between the Nitrogen gas and the vehicle EVAP system. Significant differences in temperature between them can result in a flow or pressure change during testing, causing misleading results. Typically, the EEST is stored indoors, approximately 21°C (70°F). Vehicles brought in for diagnosis may have an EVAP system at significantly different temperatures.

For Example

NOTE: **With no temperature difference between the Nitrogen gas and EVAP system, the resulting vehicle EVAP system pressure will remain stable at 3.2 kPa, 13 in. H₂O (0.5 PSI) once pressurized, providing no leaks are present.**

When the EVAP flow meter tests are performed with significant differences in temperature between the Nitrogen gas and the vehicle EVAP system, the following results can occur:

- An increase in flow during the flow meter test can be caused by a vehicle's warm EVAP system cooling down.
- A decrease in flow during the flow meter test can be caused by a vehicle's cool EVAP system warming up.

The Solution

When working on a vehicle with significant temperature differences between the vehicle EVAP system and the Nitrogen gas, allow the vehicle EVAP system temperature to stabilize as close as possible to the temperature of the Nitrogen gas before conducting the Flow Meter Test.

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) SYSTEM DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit Description

To provide maximum fuel economy under light load driving conditions, the engine control module (ECM) will command the valve lifter oil manifold assembly solenoids ON, to deactivate engine cylinders 1 and 7 on the left bank and cylinders 4 and 6 on the right bank. The valve lifter oil manifold assembly consists of 4 electrically operated normally closed solenoids, which directs pressurized engine oil to 8 deactivating valve lifters. All 4 valve lifter oil manifold assembly solenoids are connected in parallel to a fused ignition circuit supplied by the powertrain relay. The control circuit for each solenoid is connected to an individual low side driver internal to the ECM. When enabling conditions for V4 mode are met, the ECM will command each low side driver to turn ON, in engine firing order sequence.

Typical Scan Tool Data

Inhibit Parameter	Status
Operating Conditions: Engine running within cylinder deactivation operating parameters Parameter Normal Range: No	
Cylinder Deactivation Inhibit - Acceleration Request	Yes/No
Cylinder Deactivation Inhibit - A/C Compressor Clutch On	Yes/No
Cylinder Deactivation Inhibit - APP High	Yes/No
Cylinder Deactivation Inhibit - APP Rate High	Yes/No
Cylinder Deactivation Inhibit - Axle Torque Limiting	Yes/No
Cylinder Deactivation Inhibit - Brake Booster Weak Vacuum	Yes/No

Cylinder Deactivation Inhibit - Calculated Torque	Yes/No
Cylinder Deactivation Inhibit - Catalyst Temperature Low	Yes/No
Cylinder Deactivation Inhibit - Deceleration Fuel Cut-Off	Yes/No
Cylinder Deactivation Inhibit - ECT	Yes/No
Cylinder Deactivation Inhibit - Engine Oil Pressure	Yes/No
Cylinder Deactivation Inhibit - Engine Oil Temperature	Yes/No
Cylinder Deactivation Inhibit - Engine Overtemperature Protection	Yes/No
Cylinder Deactivation Inhibit - Engine Speed	Yes/No
Cylinder Deactivation Inhibit - Fuel Alcohol Content Too High	Yes/No
Cylinder Deactivation Inhibit - Fuel Alcohol Content Learn In Progress	Yes/No
Cylinder Deactivation Inhibit - Heater Performance	Yes/No
Cylinder Deactivation Inhibit - HO2S 2 Test	Yes/No
Cylinder Deactivation Inhibit - Hot Coolant Mode	Yes/No
Cylinder Deactivation Inhibit - Ignition Voltage	Yes/No
Cylinder Deactivation Inhibit - Injector Stable Time	Yes/No
Cylinder Deactivation Inhibit - Intake Manifold Weak Vacuum	Yes/No
Cylinder Deactivation Inhibit - Maximum Deactivation Time Exceeded	Yes/No
Cylinder Deactivation Inhibit - Maximum Throttle Exceeded	Yes/No
Cylinder Deactivation Inhibit - Minimum Time After TAC DTC	Yes/No
Cylinder Deactivation Inhibit - Minimum Time On All Cylinders	Yes/No
Cylinder Deactivation Inhibit - Oil Aeration	Yes/No
Cylinder Deactivation Inhibit - Piston Protection	Yes/No
Cylinder Deactivation Inhibit - RPM Limit	Yes/No
Cylinder Deactivation Inhibit - Scan Tool Override	Yes/No
Cylinder Deactivation Inhibit - Torque Reduction	Yes/No
Cylinder Deactivation Inhibit - Transmission Gear	Yes/No
Cylinder Deactivation Inhibit - Transmission Range	Yes/No
Cylinder Deactivation Inhibit - Transmission Shifting	Yes/No
Cylinder Deactivation Inhibit - Vehicle Speed Too Low	Yes/No

Diagnostic Aids

- Observe the scan tool Cylinder Deactivation Inhibit reasons to assist in determining the cause of the concern.
- Review scan tool Cylinder Deactivation Disable History to determine reason for disabling cylinder deactivation.
- A restricted valve lifter oil filter may cause a cylinder deactivation system concern. Inspect the valve lifter oil filter for a restriction or blockage. Refer to **Valve Lifter Oil Filter Replacement** .
- The valve lifter oil manifold assembly solenoids are assigned to the following engine cylinders:

- Solenoid #2 - Cylinder #4
- Solenoid #3 - Cylinder #6
- Solenoid #4 - Cylinder #7

Reference Information

Schematic Reference

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COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cylinder Deactivation (Active Fuel Management) System Description

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EN-46999 Active Fuel Management Tester

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Verify the engine oil level is within the specified level.
 - **If not within the specified level**

Repair as necessary.

- **If within the specified level**

2. Verify the engine oil pressure is within the specified range, refer to **Oil Pressure Diagnosis and Testing** .

- **If not within the specified range**

Repair as necessary.

- **If within the specified range**

3. If sent here from **DTC P0300-P0308** , continue with testing. Ignition ON, observe the scan tool DTC information.
4. Verify with a scan tool that no DTCs are set.

- **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If a DTC is not set**

5. Engine idling at the normal operating temperature.
6. Verify there is no abnormal engine noise.

- **If there is an abnormal engine noise**

Refer to **Symptoms - Engine Mechanical** for further diagnosis.

- **If no abnormal engine noise**

7. Verify the **Cylinder Deactivation (Active Fuel Management) System Compression Test** passes the compression test.

- **If compression test failed**

Test the Q43 Valve Lifter Oil Manifold Assembly, refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing**

- **If compression test passes**

8. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, remove the Q43 Valve Lifter Oil Manifold Assembly ignition fuse from the underhood fuse block. It may take up to 2 min for all vehicle systems to power down.

NOTE: **Probe each terminal at the underhood fuse block with a test lamp connected to ground to determine what terminal to connect the DMM. The test lamp should not illuminate on the circuit that needs to be tested.**

2. Connect a DMM between the ignition circuit fuse terminal going to the Q43 Valve Lifter Oil Manifold Assembly and the K20 Engine Control Module housing.
3. Ignition ON, command each Cylinder 1, 4, 6 and 7 Deactivation Solenoid ON and OFF with the scan tool.

-
4. Verify the resistance of each solenoid is between 11-18 ohms with the solenoid commanded ON.
 - **If greater than 18 ohms for all cylinder deactivation solenoids** , test the ignition circuit for an open/high resistance.
 1. Ignition OFF.
 2. Test for less than 2 ohms on the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing** .
 - **If greater than 18 ohms for one or more but not all cylinder deactivation solenoids**
 1. Ignition OFF.
 2. Test for less than 2 ohms on the appropriate control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 3. Test for 11-18 ohms between the ignition circuit and the appropriate control circuit at the Q43 Valve Lifter Oil Manifold Assembly.
 - If not within the specified value, test or replace the Q43 Valve Lifter Oil Manifold Assembly.
 - If within the specified value, test or replace the K20 Engine Control Module.
 - **If between 11-18 ohms**

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

5. Operate the vehicle within the conditions of the customer's concern while monitoring the Cylinder Deactivation Inhibit parameters.
6. Verify all Cylinder Deactivation Inhibit parameters display NO.
 - **If any parameter displays YES**

Refer to the appropriate vehicle system to determine the cause for cylinder deactivation inhibit.

- **Symptoms - Engine Controls**
- **Symptoms - Engine Cooling**
- **Symptoms - Engine Electrical**
- **Symptoms - Engine Mechanical**
- **If none of the parameters display YES**

7. Refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing** .

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Valve Lifter Oil Manifold Replacement**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

INSPECTION/MAINTENANCE SYSTEM CHECK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Description

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

Conditions for Updating the I/M System Status

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

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has 4 heated oxygen sensors, either all 4 heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The I/M System Status will indicate NO under the Completed column when any of the required tests for that system have not run. The following is a list of conditions that would set the I/M System Status indicator to NO:

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

Monitored Emission Control Systems

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

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

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

Circuit/System Verification

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

Circuit/System Testing

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

1. Observe the Engine DTC information with a scan tool.
 - If a DTC is set that would prevent the I/M System Status tests from completing, diagnose that DTC before continuing. Refer to .
2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
 - If a control module re-program or other repair is required, perform the .
3. Observe the I/M System Status indicators.
 - If any I/M System Status indicators report NO, perform the .

INSPECTION/MAINTENANCE COMPLETE SYSTEM SET PROCEDURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Description

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

Conditions for Meeting a Cold Start

- The ignition voltage between 11-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The start-up engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The start-up intake air temperature (IAT) is between 4-30°C (39-86°F).
- The difference between the IAT and the ECT is less than or equal to 6°C (10.8°F).
- The ambient air temperature is between 4-30°C (39-86°F).
- The fuel level is between 15-85 percent.

Circuit/System Verification

Review the I/M Status indicators with a scan tool. All I/M System Status indicators should report YES.

Inspection/Maintenance (I/M) System Set Procedure

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

1. Ensure that the vehicle meets the conditions for a cold start listed above.
2. The evaporative emission (EVAP) I/M System Status indicator should display YES.
 - If the EVAP I/M System Status indicator displays NO, perform the EVAP Service Bay Test, if applicable. If the EVAP Service Bay Test is NOT available, it may take up to 6 drive cycles, with up to 17 hours between drive cycles, for the EVAP I/M System Status indicator to transition to YES.
3. The O2S Heater I/M System Status indicator should display YES.
 - If the O2S Heater I/M System Status indicator displays NO, ensure that the ignition has been turned OFF for at least 10 hours.
4. Turn OFF all accessories: HVAC system, other electrical loads, including aftermarket/add-on

equipment, etc.

5. Set the vehicle parking brake and ensure the vehicle is in Park for automatic transmission or Neutral for manual transmission.
6. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc.
7. Start and idle the engine for at least 2 minutes and until 65°C (149°F) is achieved.
8. Run the engine for 6.5 minutes within the following conditions:
 - MAF parameter between 4-30 g/s
 - Engine speed steady between 1, 000-3, 000 RPM
9. Return the engine to idle for 1 minute.
10. Apply and hold the brake pedal and shift to Drive for automatic transmission or apply the clutch pedal for manual transmission and operate the vehicle within the following conditions for 2 minutes:
 - Depress the accelerator pedal until throttle position (TP) sensor angle is more than 2 percent.
 - Mass air flow (MAF) signal between 15-30 g/s
 - RPM steady between 1, 200-2, 000 RPM

NOTE: **DO NOT touch the accelerator pedal during the idle period. A change in TP sensor angle or an increase in engine speed may invalidate this portion of the test.**

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

WARNING: Refer to Road Test Warning .

14. Release the parking brake and drive vehicle at 24 km/h (15 mph) or slower for 2 minutes.
15. Continue to drive the vehicle for at least 5.5 miles between 45-112 km/h (28-70 mph) with the vehicle reaching at least 80 km/h (50 mph).
16. Release the accelerator pedal for at least 2 seconds. This will allow the vehicle to enter decel fuel cut-off.
17. Depress the accelerator pedal until the TP sensor angle is increased 3-20 percent and maintain a safe speed for 1 minute.
18. Safely stop the vehicle, with the engine in Drive for automatic transmission or in Neutral with the clutch pedal depressed and parking brake applied for manual transmission, idle for 2 minutes.
19. Shift to Park for automatic and apply the parking brake or neutral and release clutch pedal for

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

20. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 60 minutes.
21. Observe the Inspection/Maintenance (I/M) System Status with a scan tool. All of the I/M System Status indicators should display YES.
 - If the EVAP I/M System Status indicator displays NO, turn OFF the ignition for 17 hours, ensure that the vehicle meets the conditions for a cold start and repeat steps 12-18 six more times or until the EVAP I/M System Status indicator transitions to YES. If the indicator continues to display NO, refer to the to identify the DTCs that did not run. Follow the Conditions for Running the DTC in order to set the EVAP I/M System Status indicator
 - If any of the I/M System Status indicators display NO, refer to the for the indicator which did not display YES. The I/M System DTC Table identifies the DTCs associated with each I/M System Status Indicator. Follow the Conditions for Running the DTC in order to set the associated status indicator.
22. Observe the engine DTC information with a scan tool. Verify no DTCs are present.
 - If a DTC is set, diagnose using the **Diagnostic Trouble Code (DTC) List - Vehicle** . After repairs, perform the to verify no further DTCs are set.

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
If an I/M System Status indicator did NOT update to YES during the <u>Inspection/Maintenance Complete System Set Procedure</u> , review each indicator and reference this table to determine each DTC associated with the I/M System Status Indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs which, if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the Conditions for Running for each DTC listed below will allow the I/M System Status Indicators to transition to YES.	
Catalyst	<u>DTC P0420 or P0430</u>
EVAP	• <u>DTC P0442</u> • <u>DTC P0446</u> • <u>DTC P0455</u>
Fuel System	<u>DTC P219A or P219B</u>
Oxygen Sensor	<u>DTC P0133, P013A-P013F, P014A, P014B, P0153, P015A-P015D or P2270-P2273</u>
Oxygen Sensor Heater	<u>DTC P0030-P0032, P0036-P0038, P0050-P0054, P0056-P0060, P0135, P0141, P0155 or P0161</u>