

## 2010 ENGINE PERFORMANCE

### Engine Controls and Fuel - 2.8L, 3.0L, 3.2L, or 3.6L - Equinox & Terrain

## DTC P025A

### 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.

### DTC DESCRIPTOR

#### DTC P025A

Fuel Pump Control Module Enable Circuit

### DIAGNOSTIC FAULT INFORMATION

| Circuit      | Short to Ground | Open or High Resistance | Short to Voltage | Signal Performance |
|--------------|-----------------|-------------------------|------------------|--------------------|
| FPCM Control | P025A           | P025A                   | -                | P025A              |

### CIRCUIT/SYSTEM DESCRIPTION

The engine control module (ECM) supplies voltage to the fuel pump control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump control module remains active for 2 seconds, unless the engine is in crank or run. While this voltage is being received, the fuel pump control module supplies a varying voltage to the fuel tank pump module in order to maintain the desired fuel rail pressure.

### CONDITIONS FOR RUNNING THE DTC

The ignition is ON.

### CONDITIONS FOR SETTING THE DTC

The serial data message from the ECM to the fuel pump control module does not agree with the state of the control enable voltage signal supplied from the ECM to the fuel pump control module for more than 2 seconds.

### ACTION TAKEN WHEN THE DTC SETS

DTC P025A is a Type A DTC.

### CONDITIONS FOR CLEARING THE DTC

DTC P025A is a Type A DTC.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Fuel System Description (LF1)**

### **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

## **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect the harness connector at the K27 fuel pump control module.
2. Ignition OFF, connect a test lamp between the control circuit terminal 20 and ground.
3. Ignition ON, command the ECM fuel pump enable command ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
  - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
  - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
4. If all circuits test normal, replace the K27 fuel pump control module.

## **REPAIR PROCEDURES**

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

**Control Module References** for ECM or fuel pump control module replacement, setup, and programming

## **DTC P0300-P0306**

### **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.

### **DTC DESCRIPTORS**

#### **DTC P0300**

Engine Misfire Detected

#### **DTC P0301**

Cylinder 1 Misfire Detected

#### **DTC P0302**

Cylinder 2 Misfire Detected

#### **DTC P0303**

Cylinder 3 Misfire Detected

#### **DTC P0304**

Cylinder 4 Misfire Detected

#### **DTC P0305**

Cylinder 5 Misfire Detected

#### **DTC P0306**

Cylinder 6 Misfire Detected

### **CIRCUIT/SYSTEM DESCRIPTION**

The engine control module (ECM) uses information from the crankshaft position sensor and the camshaft position sensors in order to determine when an engine misfire is occurring. By monitoring variations in the

crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause 3-way catalytic converter damage. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are present. DTCs P0301 through P0306 correspond to cylinders 1 through 6. If the ECM is able to determine that a specific cylinder is misfiring, the DTC for that cylinder will set, and the corresponding fuel injector is disabled. The ECM will re-enable the fuel injector after 4 crankshaft revolutions when the misfire is not current. The ECM will re-enable the fuel injector after 8 crankshaft revolutions when the misfire is not current, if the vehicle is equipped with a manual transmission.

## **CONDITIONS FOR RUNNING THE DTC**

- DTC P0010, P0011, P0013, P0014, P0016, P0017, P0018, P0019, P0020, P0021, P0023, P0024, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0335, P0336, P0606, P0641, P0651, P1516, P2101, P2122, P2123, P2127, P2128 or P2176 is not set.
- The engine speed is between 450-6,600 RPM and steady.
- The evaporative emissions (EVAP) leak detection is not active.
- The delivered torque signal is greater than 5 % at idle.
- The delivered torque signal is between 6-29 % with the transmission in drive.
- The engine coolant temperature (ECT) is between -7 and +127°C (+19 and +261°F).
- The air conditioning compressor clutch is not changing states.
- The ECM is not receiving a rough road signal.
- The fuel level is greater than 11 %.
- The ECM is not in fuel cut-off or decel fuel cut-off mode.
- The increase in engine speed is less than 2,500-4,600 RPM/second.
- DTCs P0300 through P0306 run continuously when the above conditions exist for greater than 1,000 engine revolutions. 200 revolutions after the first failure.

## **CONDITIONS FOR SETTING THE DTC**

### **P0300**

The ECM detects a crankshaft rotation speed variation indicating a misfire rate sufficient to cause emissions levels to exceed a predetermined value.

### **P0301, P0302, P0303, P0304, P0305, P0306**

The ECM detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTCs P0300-P0306 are Type B DTCs.
- The ECM disables the fuel injector of the misfiring cylinder when a misfire is present.

## CONDITIONS FOR CLEARING THE DTC

DTCs P0300-P0306 are Type B DTCs.

## DIAGNOSTIC AIDS

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Inspect for the following possible sources:
  - A tire or wheel that is out of round or out of balance
  - Variable thickness brake rotors
  - An unbalanced drive shaft
  - Certain rough road conditions
  - Transmission operation
  - A damaged accessory drive component or belt
- High resistance in the circuits of the injectors may set a misfire DTC without setting an injector DTC. Test the injector circuits of the affected cylinder(s) for a high resistance if you suspect a condition.
- If the condition is intermittent, observing the scan tool IC Circuit Test and Fuel Injector Circuit Test Status parameters may help isolate the condition. The circuit test status parameters will change from OK or Not Run to Fault if a condition exists.
- A condition in the heated O2 sensor (HO2S) heater control circuits may set a DTC P0300.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End 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**

- **J 26792:** Spark Tester
- For equivalent regional tools, refer to **Special Tools** .

## **CIRCUIT/SYSTEM VERIFICATION**

1. Engine idling at the normal operating temperature.
  - If there is an abnormal engine noise, refer to **Symptoms - Engine Mechanical** .
2. Verify that no other DTCs are set.
  - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
3. Observe the scan tool Misfire Current Cyl. 1-6 parameters. The Misfire Current Counters should not be incrementing.
4. Engine idling, perform the cylinder power balance test with a scan tool to isolate the misfiring cylinder. The engine speed should change when each injector is disabled.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

1. Verify that the following conditions do not exist:
  - Vacuum hose splits, kinks, and incorrect connections
  - Engine vacuum leaks
  - Crankcase ventilation system for vacuum leaks
  - Fuel pressure that is too low or too high-Refer to **Fuel System Diagnosis** .
  - Contaminated Fuel-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
  - Exhaust system restrictions
  - If you find any of the above conditions, repair as necessary.
2. Ignition OFF, remove the T8 ignition coil of the misfiring cylinder, but leave the electrical connector connected.
3. Inspect the ignition coil boot for the following conditions:
  - Holes
  - Tears
  - Carbon tracking
  - Oil contamination
  - water intrusion
  - If you find any of the above conditions, repair as necessary.
4. Install the **J 26792:** Spark Tester to the boot of the appropriate T8 ignition coil and ground.

**NOTE:**        **An erratic or weak spark is considered a no spark condition.**

5. Attempt to start the engine and observe the **J 26792: Spark Tester**. The spark tester should spark.
  - If there is no spark, refer to **Electronic Ignition System Diagnosis** for diagnosis of the ignition coil.
6. Ignition OFF, remove the spark plug from the misfiring cylinder. Verify that the spark plug does not exhibit the following conditions:
  - Gas, coolant, or oil fouled-Refer to **Spark Plug Inspection** .
  - Cracked, worn, incorrectly gapped-Refer to **Ignition System Specifications** .
  - If there is a condition with the spark plug, replace the spark plug.
7. Exchange the suspected spark plug with another cylinder that is operating correctly.
8. Engine idling, observe the scan tool Misfire Current Counter parameters. The misfire should not follow the spark plug exchange.
  - If the misfire follows the spark plug, replace the spark plug.
9. If all conditions test normal, test or inspect for the following:
  - A lean or rich Q17 fuel injector.
  - An engine mechanical condition-Refer to **Symptoms - Engine Mechanical** .

## **REPAIR PROCEDURES**

- **Spark Plug Replacement**
- **Ignition Coil Replacement - Bank 1**
- **Ignition Coil Replacement - Bank 2**

## **REPAIR VERIFICATION**

1. If the customer concern was a flashing malfunction indicator lamp (MIL), refer to **DTC P0420 or P0430**.
2. Clear the DTCs with a scan tool.
3. Turn OFF the ignition for 30 s.
4. Start the engine.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
  - If the DTC fails this ignition, a misfire still exists.

## **DTC P0315**

### **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.

## **DTC DESCRIPTOR**

**DTC P0315:** Crankshaft Position System Variation Not Learned

## **CIRCUIT/SYSTEM DESCRIPTION**

The crankshaft position system variation learn feature is used to calculate reference period errors caused by slight tolerance variations in the crankshaft, and the crankshaft position sensor. The calculated error allows the engine control module (ECM) to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load conditions.

The crankshaft position system variation compensating values are stored in ECM memory after a learn procedure has been performed and the ignition switch is turned to the OFF position for at least 30 s. If the actual variation is not within the crankshaft position system variation compensating values stored in the ECM, DTC P0300 may set.

If the crankshaft position system variation values are not stored in the ECM memory or a proper ECM power down does not occur after completing the Crankshaft Position Learn Procedure, DTC P0315 sets.

## **CONDITIONS FOR RUNNING THE DTC**

DTC P0315 runs continuously.

## **CONDITIONS FOR SETTING THE DTC**

The ECM detects that the crankshaft position system variation values are not stored in memory.

## **ACTION TAKEN WHEN THE DTC SETS**

DTC P0315 is a Type A DTC.

## **CONDITIONS FOR CLEARING THE MIL/DTC**

DTC P0315 is a Type A DTC.

## **DIAGNOSTIC AIDS**

This test procedure requires that the vehicle battery has passed a load test and is completely charged. Refer to **Battery Inspection/Test** .

## **REFERENCE INFORMATION**

**Schematic Reference**

**Engine Controls Schematics**

**Connector End Views**

## Component Connector End Views

### DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

### Scan Tool Reference

Control Module References for scan tool information

## CIRCUIT/SYSTEM TESTING

**NOTE:** The Crankshaft Position System Variation Learn Procedure may have to be repeated up to 5 times before the procedure is successful.

1. Perform the Crankshaft Position System Variation Learn procedure. The scan tool should display Learned Successful.
  - If the Crankshaft Position System Variation Learn Procedure cannot be performed successfully, inspect for the following conditions:
    - Worn crankshaft main bearings
    - A damaged or misaligned reluctor wheel
    - Excessive crankshaft runout
    - A damaged crankshaft-Refer to Crankshaft and Bearing Cleaning and Inspection .
    - Interference in the signal circuit of the crankshaft position sensor
    - The ignition switch is in the ON position until there is insufficient system voltage.
    - An ECM power disconnect with the ignition ON that may have erased the crankshaft position system variation values and set DTC P0315
    - Debris between the crankshaft position sensor and the reluctor wheel
2. Verify the Learn Procedure is successful.
  - If the ECM is unable to complete the learn procedure, replace the ECM.

## REPAIR PROCEDURES

Perform the Diagnostic Repair Verification after using this diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

## DTC P0324-P0328, P0330-P0333, P06B6, OR P06B7

## 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.

## **DTC DESCRIPTORS**

### **DTC P0324**

Knock Sensor System Performance

### **DTC P0325**

Knock Sensor Circuit Bank 1

### **DTC P0326**

Knock Sensor Performance Bank 1

### **DTC P0327**

Knock Sensor Circuit Low Voltage Bank 1

### **DTC P0328**

Knock Sensor Circuit High Voltage Bank 1

### **DTC P0330**

Knock Sensor Circuit Bank 2

### **DTC P0331**

Knock Sensor Performance Bank 2

### **DTC P0332**

Knock Sensor Circuit Low Voltage Bank 2

### **DTC P0333**

Knock Sensor Circuit High Voltage Bank 2

### **DTC P06B6**

Control Module Knock Sensor Processor 1 Performance

### **DTC P06B7**

Control Module Knock Sensor Processor 2 Performance

## DIAGNOSTIC FAULT INFORMATION

| Circuit               | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-----------------------|-----------------|----------------------|------------------|--------------------|
| Knock Sensor 1 Signal | P0327           | P0325, P06B6         | P0328            | P0326              |
| Knock Sensor 2 Signal | P0332           | P0330, P06B7         | P0333            | P0331              |

## CIRCUIT/SYSTEM DESCRIPTION

The knock sensor system enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The knock sensor produces an AC voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the knock sensor signal. The ECM receives the knock sensor signal through 2 isolated signal circuits for each bank. The ECM learns a minimum knock sensor noise level at idle and uses calibrated values for the rest of the RPM range. The ECM monitors for a normal knock sensor signal. The ECM monitors the internal knock sensor processor by verifying a 20 KHz signal generated on the output circuit is detected on the return circuit.

## CONDITIONS FOR RUNNING THE DTC

### P0324, P0326 and P0331-Excessive Knock Detection Mode

- Engine speed is between 400-8,500 RPM.
- The engine coolant temperature (ECT) is greater than -40°C (-40°F).
- The intake air temperature (IAT) is greater than -40°C (-40°F).
- The DTCs run continuously when the above conditions are met.

### P0324, P0326 and P0331-Abnormal Noise Detection Mode-Improperly Bolted Knock Sensor

- Engine speed is between 2,200-8,500 RPM.
- The ECT is greater than -40°C (-40°F).
- The IAT is greater than -40°C (-40°F).
- The DTCs run continuously when the above conditions are met.

### P0325, P0327, P0328, P0330, P0332, and P0333

- Engine speed is between 400-8,500 RPM.
- The ECT is greater than -40°C (-40°F).
- The IAT is greater than -40°C (-40°F).
- The DTCs run continuously when the above conditions are met.

### P06B6 and P06B7

- Engine speed is between 400-4,000 RPM.

- The ECT is greater than -40°C (-40°F).
- The IAT is greater than -40°C (-40°F).
- The DTCs run continuously when the above conditions are met.

## **CONDITIONS FOR SETTING THE DTC**

### **P0324**

The knock sensor signal indicates an excessive engine knock is present for greater than 10 s for at least 1 single cylinder.

### **P0325 and P0330**

The knock sensor signal circuits are open for greater than 10 s.

### **P0326 and P0331**

- The signal indicates the sensor harness is connected, but the sensor is not properly bolted to the engine.

OR

- The knock sensor signal indicates an excessive engine knock is present in an entire bank.
- Either of the above conditions exist for greater than 10 s.

### **P0327 and P0332**

The knock sensor signal circuits are shorted to ground for greater than 10 s.

### **P0328 and P0333**

The knock sensor signal circuits are shorted to voltage for greater than 10 s.

### **P06B6 and P06B7**

The ECM has detected an internal knock sensor processor fault.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTCs P0324, P0325, P0326, P0327, P0328, P0330, P0331, P0332 P0333, P06B6, and P06B7 are Type B DTCs.
- The ignition timing is retarded to reduce the potential of engine damaging spark knock.

## **CONDITIONS FOR CLEARING THE DTC**

DTCs P0324, P0325, P0326, P0327, P0328, P0330, P0331, P0332 P0333, P06B6, and P06B7 are Type B DTCs.

## DIAGNOSTIC AIDS

- Inspect the knock sensor for physical damage. A knock sensor that is dropped or damaged may cause a DTC to set.
- Inspect the knock sensor for proper installation. A knock sensor that is loose or over torqued may cause a DTC to set. The knock sensor should be free of thread sealant.
- The knock sensor mounting surface should be free of burrs, casting flash, and foreign material.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End Views

### Description and Operation

#### Electronic Ignition System Description

### 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

## CIRCUIT/SYSTEM VERIFICATION

1. Engine at operating temperature, all accessories OFF, and engine speed greater than 2,000 RPM, observe the Knock Retard and Total Knock Retard parameters. The parameters should be 0°.
2. Engine idling, move the related harnesses and connectors for the KS circuits while observing the scan tool Knock Retard and Total Knock Retard parameters. The parameters should remain steady with no abrupt changes.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You

may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

### NOTE:

- Perform the Diagnostic System Check - Vehicle prior to using these diagnostic procedures.
- If an engine mechanical noise can be heard, repair the condition before proceeding with this diagnostic. Refer to Symptoms - Engine Mechanical .

### P0324

### NOTE:

If DTC P0325, P0326, P0327, P0328, P0330, P0332, or P0333 are also set, diagnose those DTCs first.

DTC P0324 indicates an internal control module circuitry failure. Replace the K20 ECM.

### P0325, P0326, P0327, P0328, P0330, P0332, P0333

1. Ignition OFF, disconnect the affected B68 KS.
2. Ignition OFF. Connect a DMM to both B68 KS signal circuits, terminals A and B, at the affected B68 KS. Set the DMM to the 400 mV AC scale, select the Hz mode. Let the reading stabilize at 0 Hz.

### NOTE:

**DO NOT tap on plastic engine components.**

3. Tap on the engine block with a non-metallic object near the affected B68 KS and observe the DMM for a fluctuating frequency.
  - If the DMM does not display a fluctuating frequency while tapping on the engine block then replace the affected B68 KS.
4. Verify the affected B68 KS is properly tightened, refer to Fastener Tightening Specifications .
5. Ignition OFF, with appropriate length jumper wires, connect the B68 KS1 harness to the B68 KS2 sensor and the B68 KS2 harness to the B68 KS1 sensor.
6. Monitor the DTCs using a scan tool. Operate the vehicle within the conditions for running the DTC. Verify the fault does not follow the sensor in question.
  - If the fault follows the sensor in question, replace the appropriate B68 KS.
7. Ignition OFF, remove the jumper wires from the previous step.
8. Measure for 1-4 volts between each of the following circuits and ground on the K20 ECM side of the harness connector:
  - The B68 KS signal circuit, terminal A or 1
  - The B68 KS signal circuit, terminal B or 2
  - If less than the specified range, test the circuits for a short to ground or an open/high resistance. If the circuits test normal, replace the K20 ECM.
  - If greater than the specified range, test the circuits for a short to voltage. If the circuits test normal,

replace the K20 ECM.

9. Test for intermittent or poor connections at the ECM, B68 KS, and in-line connectors where present.
10. If all circuits test normal, replace the K20 ECM.

## REPAIR PROCEDURES

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

- **Knock Sensor Replacement - Bank 1**
- **Knock Sensor Replacement - Bank 2**
- **Control Module References** for ECM replacement, setup, and programming

## DTC P0335 (W/LF1)

### 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.

### DTC DESCRIPTOR

#### DTC P0335

Crankshaft Position Sensor Circuit

### DIAGNOSTIC FAULT INFORMATION

| Circuit                                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference Circuit                     | P0651           | P0335                | P0651, P2135     | -                  |
| Crankshaft Position Sensor Signal Circuit | P0335           | P0335                | P0335            | P0336              |
| Low Reference Circuit                     | -               | P0335                | P0335            | -                  |

### CIRCUIT/SYSTEM DESCRIPTION

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit and an output signal circuit. The crankshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 58-tooth reluctor wheel on the crankshaft. Each tooth on the reluctor wheel is spaced at 60-tooth spacing, with 2 missing teeth for the reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency, with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal, which represents an image of the crankshaft reluctor wheel, to the ECM as each tooth on

the wheel rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft reluctor wheel reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and to detect cylinder misfire.

### **CONDITIONS FOR RUNNING THE DTC**

- DTCs P0101, P0102, P0103, P0340, P0341, P0641, or P0651 P0697 are not set.
- The engine is cranking or running.
- The airflow into the engine is greater than 3 g/s.
- The DTC runs continuously when the above conditions are met.

### **CONDITIONS FOR SETTING THE DTC**

- The ECM detects that the starter is commanded ON and the engine has been cranking for more than 4 seconds without a crankshaft position sensor pulse.
- The ECM detects that the engine has been running but has not received a crankshaft position sensor pulse for 2 of 10 engine revolutions.

### **ACTION TAKEN WHEN THE DTC SETS**

- DTC P0335 is a Type B DTC.
- The camshaft position actuator is commanded to the Home or Parked position.

### **CONDITIONS FOR CLEARING THE MIL/DTC**

DTC P0335 is a Type B DTC.

### **REFERENCE INFORMATION**

#### **Schematic Reference**

#### **Engine Controls Schematics**

#### **Connector End View Reference**

#### **Component Connector End Views**

#### **Description and Operation**

- **Electronic Ignition System Description**
- **Engine Control Module Description**

#### **Electrical Information Reference**

- **Circuit Testing**
- **Connector Repairs**
- **Wiring Repairs**

## **DTC Type Reference**

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

## **Scan Tool Reference**

**Engine Control Module Scan Tool Information (LF1,LFW)** or **Engine Control Module Scan Tool Information (LAF)** for scan tool information

## **CIRCUIT/SYSTEM VERIFICATION**

1. Engine idling, observe the scan tool Crankshaft Position Active Counter parameter. The parameter should be incrementing.
2. Engine idling, observe the DTC information with a scan tool. DTC P0335 should not set.
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect the B26 crankshaft position sensor connector.
2. Ignition OFF, vehicle systems OFF, this may take up to 2 minutes, test for less than 3 ohms between low reference circuit terminal 1 and ground.
  - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
  - If less than the specified range, test the 5 V reference circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Test for 4.8-5.2 V between the signal circuit terminal 2 and ground.
  - If less than the specified range, test the signal circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Ignition ON, engine OFF, using a 3 A jumper wire connected to ground, momentarily touch the crankshaft position sensor signal circuit terminal 2 repeatedly. The crankshaft position active counter parameter should increment.
  - If the crankshaft position active counter parameter does not increment, replace the K20 ECM.
  - If the crankshaft position active counter increments, test or replace the B26 crankshaft position

sensor.

## COMPONENT TESTING

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

1. Inspect the B26 crankshaft position sensor for looseness and correct installation. Remove the crankshaft position sensor from the engine and inspect the sensor and the O-ring for damage.
  - If the sensor is loose, incorrectly installed, or damaged, repair or replace the B26 crankshaft position sensor.
2. Connect the crankshaft position sensor connector to the crankshaft position sensor. Turn ON the ignition, with the engine OFF.
3. Observe the Crankshaft Position Active Counter parameter with a scan tool. Pass a flat steel object by the tip of the sensor repeatedly. The crankshaft position active counter parameter should increment.
  - If the function does not perform as specified, replace the B26 crankshaft position sensor.

## REPAIR PROCEDURES

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

- **Crankshaft Position Sensor Replacement**
- **Control Module References** for ECM replacement, setup, and programming

## DTC P0336 (W/LF1)

### 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.

### DTC DESCRIPTOR

#### DTC P0336

Crankshaft Position Sensor Performance

### DIAGNOSTIC FAULT INFORMATION

| Circuit                           | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-----------------------------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference Circuit             | P0651           | P0335                | P0651, P2135     | -                  |
| Crankshaft Position Sensor Signal | P0335           | P0335                | P0335            | P0336              |

|                       |   |       |       |   |
|-----------------------|---|-------|-------|---|
| Circuit               |   |       |       |   |
| Low Reference Circuit | - | P0335 | P0335 | - |

## CIRCUIT/SYSTEM DESCRIPTION

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit and an output signal circuit. The crankshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 58-tooth reluctor wheel on the crankshaft. Each tooth on the reluctor wheel is spaced at 60-tooth spacing, with 2 missing teeth for the reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency, with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal, which represents an image of the crankshaft reluctor wheel, to the ECM as each tooth on the wheel rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft reluctor wheel reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and to detect cylinder misfire.

## CONDITIONS FOR RUNNING THE DTC

- DTCs P0101, P0102, P0103, P0340, P0341, P0641, or P0651 are not set.
- The engine is cranking or running.
- The airflow into the engine is greater than 3 g/s.
- The DTC runs continuously when the above conditions are met.

## CONDITIONS FOR SETTING THE DTC

- The ECM detects that the engine is running, but receives less than 51 or more than 65 crankshaft position sensor pulses each engine revolution for 8 of 10 engine revolutions.
- The ECM detects that the engine is running, but more than 19 resyncs occur within 25 seconds.
- The ECM detects that the engine has been running, but the crankshaft does not sync for 0.4 second.

## ACTION TAKEN WHEN THE DTC SETS

- DTC P0336 is a Type B DTC.
- The camshaft position actuator is commanded to the Home or Parked position.

## CONDITIONS FOR CLEARING THE MIL/DTC

DTC P0336 is a Type B DTC.

## REFERENCE INFORMATION

### Schematic Reference

## **Engine Controls Schematics**

### **Connector End View Reference**

## **Component Connector End Views**

### **Description and Operation**

- **Electronic Ignition System Description**
- **Engine Control Module Description**

### **Electrical Information Reference**

- **Circuit Testing**
- **Connector Repairs**
- **Wiring Repairs**

### **DTC Type Reference**

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

### **Scan Tool Reference**

**Engine Control Module Scan Tool Information (LF1,LFW)** or **Engine Control Module Scan Tool Information (LAF)** for scan tool information

## **CIRCUIT/SYSTEM VERIFICATION**

1. Engine idling, observe the scan tool Crankshaft Position Active Counter parameter. The parameter should be incrementing.
2. Engine idling, observe the DTC information with a scan tool. DTC P0335 should not set.
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect the B26 crankshaft position sensor connector.
2. Ignition OFF, vehicle systems OFF, this may take 2 minutes, test for less than 3 ohms between low reference circuit terminal 1 and ground.
  - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
  - If less than the specified range, test the 5 V reference circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit

tests normal, replace the K20 ECM.

4. Test for 4.8-5.2 V between the signal circuit terminal 2 and ground.
  - If less than the specified range, test the signal circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Ignition ON, engine OFF, using a 3 A jumper wire connected to ground, momentarily touch the crankshaft position sensor signal circuit terminal 2 repeatedly. The Crankshaft Position Active Counter parameter should increment.
  - If the Crankshaft Position Active Counter parameter does not increment, replace the K20 ECM.
  - If the Crankshaft Position Active Counter increments, test or replace the B26 crankshaft position sensor.

## COMPONENT TESTING

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

1. Inspect the B26 crankshaft position sensor for looseness and correct installation. Remove the crankshaft position sensor from the engine and inspect the sensor and the O-ring for damage.
  - If the sensor is loose, incorrectly installed, or damaged, repair or replace the B26 crankshaft position sensor.
2. Connect the crankshaft position sensor connector to the crankshaft position sensor. Turn ON the ignition, with the engine OFF.
3. Observe the Crankshaft Position Active Counter parameter with a scan tool. Pass a steel object by the tip of the sensor repeatedly. The Crankshaft Position Active Counter parameter should increment.
  - If the function does not perform as specified, replace the B26 crankshaft position sensor.

## REPAIR PROCEDURES

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

- **Crankshaft Position Sensor Replacement**
- **Control Module References** for ECM replacement, setup, and programming

## DTC P0340, P0345, P0365, OR P0390 (W/LF1)

### 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.

## DTC DESCRIPTORS

### DTC P0340

Intake Camshaft Position Sensor Circuit Bank 1

### DTC P0345

Intake Camshaft Position Sensor Circuit Bank 2

### DTC P0365

Exhaust Camshaft Position Sensor Circuit Bank 1

### DTC P0390

Exhaust Camshaft Position Sensor Circuit Bank 2

## DIAGNOSTIC FAULT INFORMATION

| Circuit                                 | Short to Ground                   | Open/High Resistance       | Short to Voltage           | Signal Performance         |
|-----------------------------------------|-----------------------------------|----------------------------|----------------------------|----------------------------|
| 5 V Reference Circuit                   | P0641, P0452, P0107, P0532, P0522 | P0340, P0345, P0365, P0390 | P0641                      | -                          |
| Camshaft Position Sensor Signal Circuit | P0340, P0345, P0365, P0390        | P0340, P0345, P0365, P0390 | P0340, P0345, P0365, P0390 | P0341, P0346, P0366, P0391 |
| Low Reference Circuit                   | -                                 | P0340, P0345, P0365, P0390 | P0340, P0345, P0365, P0390 | -                          |

## CIRCUIT/SYSTEM DESCRIPTION

The 4X camshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The camshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 4-tooth reluctor wheel attached to the camshaft. As each reluctor wheel tooth rotates past the camshaft position sensor, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The sensor returns a digital ON/OFF DC voltage pulse of varying frequency, with 4 varying width output pulses per camshaft revolution that represent an image of the camshaft reluctor wheel. The frequency of the camshaft position sensor output depends on the velocity of the camshaft. The ECM decodes the narrow and wide tooth pattern to identify camshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses camshaft position sensor output information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and for limp-home operation.

## CONDITIONS FOR RUNNING THE DTC

**NOTE:**        **The ECM detects engine movement by sensing the airflow through the MAF sensor when airflow is greater than 3 g/s, or by sensing crankshaft position sensor pulses.**

- DTC P0102, P0103, P0335, P0336, P0641, P0651, or P0697 is not set.
- The engine is cranking or running.
- The DTC runs continuously when the above conditions are met.

## **CONDITIONS FOR SETTING THE DTC**

- The ECM detects that the starter is commanded ON and the engine has been cranking for more than 4 seconds without a camshaft position sensor pulse.
- The ECM detects that the engine has started, but did not receive a camshaft position sensor pulse during the first engine revolution.
- The ECM detects that the engine is running, but does not receive a camshaft position sensor pulse for 800 of 1,000 engine cycles.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTCs P0340, P0345, P0365, and P0390 are Type B DTCs.
- The camshaft position actuator is commanded to the Home or Parked position.

## **CONDITIONS FOR CLEARING THE MIL/DTC**

DTCs P0340, P0345, P0365, and P0390 are Type B DTCs.

## **DIAGNOSTIC AIDS**

With a DTC set, the engine may crank for an extended period of time at start-up.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Electronic Ignition System Description**

### **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

**Engine Control Module Scan Tool Information (LF1,LFW)** or **Engine Control Module Scan Tool Information (LAF)** for scan tool information

## CIRCUIT/SYSTEM VERIFICATION

1. With the ignition OFF, inspect the engine wiring harnesses carrying the B23 camshaft position sensor circuits for the following conditions:
  - Close routing of aftermarket electrical equipment
  - Close to solenoids, motors, and relays
  - Correct any wire harness routing or component placement conditions if it is determined to be a possible source of electrical interference.
2. Observe the following scan tool parameters are all incrementing:
  - Exhaust Camshaft Position Active Counter Bank 1
  - Intake Camshaft Position Active Counter Bank 1
  - Exhaust Camshaft Position Active Counter Bank 2
  - Intake Camshaft Position Active Counter Bank 2
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

1. Ignition OFF, all vehicle systems OFF, this may take 2 minutes, disconnect the affected B23 camshaft position sensor connector.
2. Test for less than 3 ohms between the low reference circuit terminal 1 and ground.
  - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.

**NOTE:**        **The control module or the sensor may be damaged if the circuit is shorted to B+ voltage.**

3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

- If less than the specified range, test the 5 V reference circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Test for 4.8-5.2 V between the signal circuit terminal 2 and ground.
- If less than the specified range, test the affected signal circuit for an open/high resistance or short to ground. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the affected signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Ignition ON, using a 3 A fused jumper wire connected to ground; momentarily touch the camshaft position sensor signal circuit terminal 2 repeatedly. The appropriate camshaft position active counter parameter should increment.
- If the camshaft position active counter does not increment, replace the K20 ECM.
  - If the circuits test normal, replace the B23 camshaft position sensor.

## COMPONENT TESTING

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

1. Inspect the B23 crankshaft position sensor for looseness and correct installation. Remove the crankshaft position sensor from the engine and inspect the sensor and the O-ring for damage.
  - If the sensor is loose, incorrectly installed, or damaged, repair or replace the B23 crankshaft position sensor.
2. Connect the crankshaft position sensor connector to the crankshaft position sensor.
3. Ignition ON, observe the applicable camshaft position active counter parameter with a scan tool. Pass a steel object by the tip of the sensor repeatedly. The camshaft position active counter parameter should increment.
  - If the function does not perform as specified, replace the B23 camshaft position sensor.

## REPAIR PROCEDURES

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

- **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust**
- **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake**
- **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake**
- **Control Module References** for K20 ECM replacement, setup, and programming

## DTC P0341, P0346, P0366, OR P0391 (W/LF1)

## 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.

## DTC DESCRIPTORS

### DTC P0341

Intake Camshaft Position Sensor Performance Bank 1

### DTC P0346

Intake Camshaft Position Sensor Performance Bank 2

### DTC P0366

Exhaust Camshaft Position Sensor Performance Bank 1

### DTC P0391

Exhaust Camshaft Position Sensor Performance Bank 2

## DIAGNOSTIC FAULT INFORMATION

| Circuit                                 | Short to Ground                   | Open/High Resistance       | Short to Voltage           | Signal Performance         |
|-----------------------------------------|-----------------------------------|----------------------------|----------------------------|----------------------------|
| 5 V Reference Circuit                   | P0641, P0452, P0107, P0532, P0522 | P0340, P0345, P0365, P0390 | P0641                      | -                          |
| Camshaft Position Sensor Signal Circuit | P0340, P0345, P0365, P0390        | P0340, P0345, P0365, P0390 | P0340, P0345, P0365, P0390 | P0341, P0346, P0366, P0391 |
| Low Reference Circuit                   | -                                 | P0340, P0345, P0365, P0390 | P0340, P0345, P0365, P0390 | -                          |

## CIRCUIT/SYSTEM DESCRIPTION

The 4X camshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The camshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 4-tooth reluctor wheel attached to the camshaft. As each reluctor wheel tooth rotates past the camshaft position sensor, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The sensor returns a digital ON/OFF DC voltage pulse of varying frequency, with 4 varying width output pulses per camshaft revolution that represent an image of the camshaft reluctor wheel. The frequency of the camshaft position sensor output depends on the velocity of the camshaft. The ECM decodes the narrow and wide tooth pattern to identify camshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses camshaft position sensor output

information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and for limp-home operation.

## **CONDITIONS FOR RUNNING THE DTC**

- DTCs P0335, P0336, P0641, P0651, or P0697 are not set.
- The engine is cranking or running.
- The DTC runs continuously when the above conditions are met.

## **CONDITIONS FOR SETTING THE DTC**

- The ECM detects that the engine has started, but has received either of the following during the first engine revolution:
  - Less than or more than 4 camshaft position sensor pulses, if equipped with an automatic transmission
  - Less than 4 or more than 8 camshaft position sensor pulses, if equipped with a manual transmission
- The ECM detects that the engine is running, but receives less than 398 camshaft position or more than 402 camshaft position sensor pulses per 100 engine cycles in 800 of 1000 engine cycles.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTCs P0341, P0346, P0366, and P0391 are Type B DTCs.
- The camshaft position actuator is commanded to the Home or Parked position.
- The ignition system defaults to a failed camshaft position sensor based on the crankshaft position sensor.

## **CONDITIONS FOR CLEARING THE MIL/DTC**

- DTCs P0341, P0346, P0366, and P0391 are Type B DTCs.
- With a DTC set, the engine may crank for an extended period of time at start-up.

## **DIAGNOSTIC AIDS**

With a DTC set, the engine may crank for an extended period of time at start-up.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

## **Electronic Ignition System Description**

### **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**

**Engine Control Module Scan Tool Information (LF1,LFW)** or **Engine Control Module Scan Tool Information (LAF)** for scan tool information

### **CIRCUIT/SYSTEM VERIFICATION**

1. If DTC P0340, P0345, P0365, or P0390 are also set, diagnose those DTCs first
2. With the ignition OFF, inspect the engine wiring harnesses carrying the B23 camshaft position sensor circuits for the following conditions:
  - Close routing of aftermarket electrical equipment
  - Close to solenoids, motors, and relays
  - Correct any wire harness routing or component placement conditions if it is determined to be a possible source of electrical interference.
3. Observe the following scan tool parameters are all incrementing:
  - Exhaust Camshaft Position Active Counter Bank 1
  - Intake Camshaft Position Active Counter Bank 1
  - Exhaust Camshaft Position Active Counter Bank 2
  - Intake Camshaft Position Active Counter Bank 2
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

### **CIRCUIT/SYSTEM TESTING**

1. Engine idling, move the related harnesses/connectors of the B23 camshaft position sensor while monitoring the scan tool Camshaft Position Variance parameter. The Camshaft Position Variance parameter should not change when moving the harness/connectors.
  - If the above condition exists, repair the harness/connectors as necessary.
2. Ignition OFF, inspect the B23 camshaft position sensor for correct installation.

- If the B23 camshaft position sensor is loose, inspect the sensor and the O-ring for damage and replace as necessary.
- 3. Disconnect the harness connector at the B23 camshaft position sensor.
- 4. Ignition OFF, all vehicle systems OFF, this may take 2 minutes, test for less than 5 ohms between the low reference circuit terminal B and ground.
  - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
- 5. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal A and ground.
  - If less than the specified range, test the 5 V reference circuit for a short to ground, or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
- 6. Test for 4.8-5.2 V between the signal circuit terminal C and ground.
  - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
  - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
- 7. Ignition OFF, connect a 3 A fused jumper wire to the camshaft position signal circuit terminal C.
- 8. Ignition ON, momentarily touch the end of the fused jumper wire to ground while monitoring the scan tool camshaft position active counter. The camshaft position active counter should increment.
  - If the camshaft position active counter does not increment, replace the K20 ECM.
- 9. If all circuits test normal, replace the B23 camshaft position sensor.

## COMPONENT TESTING

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

- 1. Inspect the B23 camshaft position sensor for looseness and correct installation. Remove the camshaft position sensor from the engine and inspect the sensor and the O-ring for damage.
  - If the sensor is loose, incorrectly installed, or damaged, repair or replace the B23 crankshaft position sensor.
- 2. Connect the camshaft position sensor connector to the camshaft position sensor. Turn ON the ignition, with the engine OFF.
- 3. Ignition ON, observe the applicable camshaft position active counter parameter with a scan tool. Pass a steel object by the tip of the sensor repeatedly. The camshaft position active counter parameter should increment.
  - If the function does not perform as specified, replace the B23 camshaft position sensor.

## REPAIR PROCEDURES

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

- **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust**
- **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake**
- **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust**
- **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake**
- **Control Module References** for ECM replacement, setup, and programming

## DTC P0351-P0356 (LF1)

### 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.

### DTC DESCRIPTORS

#### DTC P0351

Ignition Coil 1 Control Circuit

#### DTC P0352

Ignition Coil 2 Control Circuit

#### DTC P0353

Ignition Coil 3 Control Circuit

#### DTC P0354

Ignition Coil 4 Control Circuit

#### DTC P0355

Ignition Coil 5 Control Circuit

#### DTC P0356

Ignition Coil 6 Control Circuit

### DIAGNOSTIC FAULT INFORMATION

| Circuit          | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|------------------|-----------------|----------------------|------------------|--------------------|
| Ignition Voltage | 1               | 2                    | -                | -                  |

|                                                                                                                                                |              |                                                |              |   |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------------|--------------|---|
| Ignition Coil 1 Control Circuit                                                                                                                | P0300, P0351 | P0300, P0351                                   | P0300, P0351 | - |
| Ignition Coil 2 Control Circuit                                                                                                                | P0300, P0352 | P0300, P0352                                   | P0300, P0352 | - |
| Ignition Coil 3 Control Circuit                                                                                                                | P0300, P0353 | P0300, P0353                                   | P0300, P0353 | - |
| Ignition Coil 4 Control Circuit                                                                                                                | P0300, P0354 | P0300, P0354                                   | P0300, P0354 | - |
| Ignition Coil 5 Control Circuit                                                                                                                | P0300, P0355 | P0300, P0355                                   | P0300, P0355 | - |
| Ignition Coil 6 Control Circuit                                                                                                                | P0300, P0356 | P0300, P0356                                   | P0300, P0356 | - |
| Low Reference                                                                                                                                  | -            | P0351, P0352,<br>P0353, P0354,<br>P0355, P0356 | -            | - |
| 1. The Engine Cranks But Does Not Run and opens the fuse that supplies voltage to the ignition coils.<br>2. The Engine Cranks But Does Not Run |              |                                                |              |   |

## CIRCUIT/SYSTEM DESCRIPTION

The ignition system on this engine uses an individual coil/module for each cylinder. The engine control module (ECM) controls the spark event for each cylinder through the eight individual ignition control circuits. When the ECM commands the ignition control circuit ON, electrical current will flow through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM will command the ignition control circuit OFF, interrupting current flow through the primary winding. The magnetic field created by the primary winding will collapse across the secondary coil windings, producing a high voltage across the spark plug electrodes. The ECM uses information from the crankshaft position sensor, and the camshaft position sensor for sequencing and timing of the spark events.

## CONDITIONS FOR RUNNING THE DTC

- The engine is running.
- The ignition voltage is greater than 6 V.
- DTC P0351-P0356 runs continuously when the above conditions are met.

## CONDITIONS FOR SETTING THE DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 5 s.

## ACTION TAKEN WHEN THE DTC SETS

DTCs P0351-P0356 are Type B DTCs.

## CONDITIONS FOR CLEARING THE MIL/DTC

DTCs P0351-P0356 are Type B DTCs.

## DIAGNOSTIC AIDS

A high resistance condition on any ignition control circuit can cause an engine misfire without setting DTC P0351-P0356.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End Views

### Description and Operation

#### 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 for scan tool information

## CIRCUIT/SYSTEM VERIFICATION

1. Engine running, observe the following scan tool control circuit status parameters for the appropriate cylinder T8 ignition coil:
  - Ignition Coil 1-6 Control Circuit Low Voltage Test Status
  - Ignition Coil 1-6 Control Circuit Open Test Status
  - Ignition Coil 1-6 Control Circuit High Voltage Test Status

Each parameter should display Not Run or OK.
2. Engine idling, observe the DTC information with a scan tool. DTC P0351, P0352, P0353, P0354, P0355, or P0356 should not set.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the harness connector at the appropriate T8 ignition coil.
2. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all the systems to power

down. Test for less than 5 ohms between the ground circuit terminal A and ground.

- If greater than the specified range, repair the ground circuit for an open/high resistance.

3. Ignition OFF, test for less than 5 ohms between the low reference circuit terminal B and ground.

- If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.

4. Ignition ON, verify that a test lamp illuminates between the ignition voltage circuit terminal D and ground.

- If the test lamp does not illuminate, test the ignition voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal and the ignition voltage circuit fuse is open, test all components connected to the ignition voltage circuit and replace as necessary.

5. Engine idling at operating temperature, test for 0.250-0.350 V between the appropriate ignition control circuit terminal C and ground.

- If less than the specified range, test the ignition control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
- If greater than the specified range, test the ignition control circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.

6. If all circuits test normal, test or replace the T8 ignition coil.

## REPAIR PROCEDURES

- T8 **Ignition Coil Replacement - Bank 1**
- T8 **Ignition Coil Replacement - Bank 2**
- **Control Module References** for ECM replacement, setup, and programming

## REPAIR VERIFICATION

**NOTE:** An ignition control circuit fault condition will result in an engine misfire, and under certain driving conditions could possibly overheat the 3-way catalytic converter.

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Turn the ignition OFF for 60 s.
5. If the repair is related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and perform the appropriate diagnostic procedure.
6. To verify that the performance of the catalytic converter has not been affected by the condition that set this DTC, perform the Repair Verification for DTC P0420 or P0430.

## DTC P0420 OR P0430

## 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.

## DTC DESCRIPTOR

### DTC P0420

Catalyst System Low Efficiency Bank 1

### DTC P0430

Catalyst System Low Efficiency Bank 2

## CIRCUIT/SYSTEM DESCRIPTION

A 3-way catalytic converter (TWC) controls emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converter promotes a chemical reaction, which oxidizes the HC and the CO that are present in the exhaust gas. This process converts the HC and the CO into water vapor and carbon dioxide (CO<sub>2</sub>), and reduces the NOx, converting the NOx into nitrogen. The catalytic converter also stores oxygen. The engine control module (ECM) monitors this process by using a heated oxygen sensor (HO<sub>2</sub>S) that is in the exhaust stream after the TWC. The HO<sub>2</sub>S 2 produces an output signal that the ECM uses to calculate the oxygen storage capacity of the catalyst. This indicates the ability of the catalyst to convert the exhaust emissions efficiently. The ECM monitors the efficiency of the catalyst by allowing the catalyst to heat, then wait for a stabilization period while the engine is idling. The ECM then adds and removes fuel while monitoring the HO<sub>2</sub>S 2. When the catalyst is functioning properly, the HO<sub>2</sub>S 2 response to the extra fuel is slow compared to the response of the HO<sub>2</sub>S 1, which is located before the TWC. When the HO<sub>2</sub>S 2 response is near that of the HO<sub>2</sub>S 1, the oxygen storage capability and efficiency of the catalyst may be degraded below an acceptable threshold.

## CONDITIONS FOR RUNNING THE DTC

- DTCs P000A, P000B, P000C, P000D, P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0030, P0031, P0032, P0050, P0051, P0052, P0100, P0101, P0102, P0103, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0130, P0131, P0132, P0133, P0135, P0137, P0138, P013A, P013C, P013E, P0140, P0141, P014A, P0150, P0151, P0152, P0153, P0155, P0157, P0158, P0160, P0161, P0221, P0222, P0223, P0300, P0301-P0306, P0443, P0455, P0458, P0459, P0496, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095, P2096, P2097, P2098, P2099, P2100, P2101, P2107, P2119, P2122, P2123, P2127, P2128, P2138, P2176, P2177, P2178, P2179, P2180, P2187, P2188, P2189, P2190, P2232, P2235, P2270, P2271, P2272, or P2273 is not set.
- Before the ECM performs the idle test, the vehicle must be driven under the following conditions:
  - The engine speed is greater than 915 RPM
  - The engine run time is greater than a calibrated value
  - Both conditions exist for greater than 15 seconds

- The throttle is in the rest position.
- The intake air temperature (IAT) is between -20 to +250°C (-4 to +482°F).
- The ignition voltage is greater than 11 volts.
- The engine coolant temperature (ECT) is between 40-127°C (104-261°F).
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine has been idling less than 50 seconds.
- The vehicle speed is less than 2 km/h (1 mph).
- The short term fuel trim is learned.
- The air flow into the engine is between 3-13 g/s.
- The EVAP purge concentration is learned.
- The catalytic converter (TWC) calculated temperature is between 450-250°C (842-1,742°F).
- The engine is operating in Closed Loop.
- The transmission is not in P/N (automatic transmission only).

This diagnostic attempts one test during each valid idle period once the above conditions have been met. This diagnostic attempts up to 8 tests during each drive cycle.

### **CONDITIONS FOR SETTING THE DTC**

The ECM determines that the efficiency of the catalyst has degraded below a calibrated threshold.

### **ACTION TAKEN WHEN THE DTC SETS**

DTC P0420 and P0430 are Type A DTCs.

### **CONDITIONS FOR CLEARING THE DTC**

DTC P0420 and P0430 are Type A DTCs.

### **DIAGNOSTIC AIDS**

Inspect for the following conditions, which may cause a catalytic converter to degrade:

- An engine misfire
- High engine oil or high coolant consumption
- Retarded spark timing
- A weak or poor spark
- A lean fuel mixture
- A rich fuel mixture
- A damaged oxygen sensor or wiring harness

### **REFERENCE INFORMATION**

## DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

## Scan Tool Reference

Control Module References for scan tool information

## CIRCUIT/SYSTEM TESTING

1. Engine idling, observe the DTC information with a scan tool. Verify there are no HO2S or misfire DTCs set.
  - If any of the DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** to diagnosis the applicable DTC, before proceeding with this diagnostic procedure.
2. Verify the following conditions do not exist with the catalytic converter:
  - Dents
  - A severe discoloration caused by excessive temperatures
  - Road damage
  - An internal rattle caused by damaged catalyst substrate
  - Restrictions
  - If a condition is found, replace the catalytic converter.
3. Verify the following conditions do not exist with the exhaust system:
  - Leaks
  - Physical damage
  - Loose or missing hardware
  - Properly torqued HO2S
  - If a condition is found, repair the exhaust system.
4. Verify the following conditions do not exist with the HO2S 2:
  - A grounded wiring harness
  - Damage
  - If a condition is found, replace the HO2S 2.
5. If no physical condition is detected and the HO2S 2 is as active as the HO2S 1 after operating the engine at 1,500 RPM for 1 minute and then returning to a stabilized idle, then replace the appropriate catalytic converter.

## REPAIR PROCEDURES

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

- **Exhaust Leakage**
- **Restricted Exhaust**
- **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)**

- **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**
- **Catalytic Converter Replacement - Left Side (LF1)**
- **Catalytic Converter Replacement - Right Side (LF1)**

## **DTC P0442**

### **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.

### **DTC DESCRIPTOR**

#### **DTC P0442**

Evaporative Emission (EVAP) System Small Leak Detected

### **CIRCUIT/SYSTEM DESCRIPTION**

The engine off natural vacuum (EONV) test is the small leak detection diagnostic for the evaporative emission system. This diagnostic tests the evaporative emission (EVAP) system for a small leak when the key is turned OFF and the correct conditions are met. Heat from the exhaust system is transferred into the fuel tank while the vehicle is operating. When the vehicle is turned OFF and the EVAP system is sealed a change in the fuel tank vapor temperature occurs which results in a corresponding pressure change in the fuel tank vapor space. This change is monitored by the ECM using the fuel tank pressure sensor input. With a leak in the system, the amount of pressure change will be less than that of a sealed system.

### **CONDITIONS FOR RUNNING THE DTC**

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0222, P0223, P0443, P0446, P0449, P0451, P0452, P0453, P0454, P0455, P0461, P0462, P0463, P0464, P0496, P0502, P0503, P0608, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138 are not set.
- The ignition 1 voltage is between 10-16 V.
- The barometric pressure (BARO) is greater than 74 kPa.
- No fuel filling during the EONV test period.
- The fuel level is between 15-85 %.
- The start-up engine coolant temperature (ECT) and the start-up intake air temperature (IAT) are between 0-40°C (32-104°F).
- The barometric pressure (BARO) is more than 74 kPa.
- The engine run time before engine shut-off was greater than 10 min.
- The drive distance before engine shut-off was more than 5 kilometers (3.1 miles).
- The ignition is OFF.

- The ambient air temperature at the end of the drive cycle is between 0-32°C (32-93°F).
- DTC P0442 runs once per drive cycle during the hot soak period after the ignition is turned OFF and may require up to 45 min to complete. The controller will not make more than 2 test attempts per day. The time since the last completed EONV test must be at least 17 hours

## **CONDITIONS FOR SETTING THE DTC**

- The ECM detects a leak in the EVAP system that is greater than a calibrated amount.
- The ECM must complete several EONV tests before the diagnostic can turn the MIL on or off.

## **ACTION TAKEN WHEN THE DTC SETS**

DTC P0442 is a Type A DTC.

## **CONDITIONS FOR CLEARING THE DTC**

DTC P0442 is a Type A DTC.

## **DIAGNOSTIC AIDS**

- The evaporative emission system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. When injecting smoke at the service port tool temporarily leave the EVAP vent solenoid valve open until smoke is observed then close the system and continue testing.
- To help locate intermittent leaks using the **EN 41413-A: EEST**, move all evaporative emission components while observing smoke with the **EN 41413-SPT: White Light**.
- Individual components can be isolated and tested using adapters in the **EN 41413-300: Kit**.
- A condition may exist where a leak in the evaporative emission system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a vacuum in the evaporative emission system and then observe the fuel tank pressure parameter for vacuum decay.

## **REFERENCE INFORMATION**

### **DTC Type Reference**

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

### **Description and Operation**

### **Evaporative Emission Control System Description**

### **Scan Tool Reference**

### **Control Module References** for scan tool information

## Special Tools

- **CH 48096:** EVAP Service Port Access Tool
- **EN 41413 A:** Evaporative Emissions System Tester (EEST)
- **EN 41413 300:** EVAP Cap and Plug Kit
- **EN 41413 SPT:** High Intensity White Light

For equivalent regional tools, refer to **Special Tools** .

## CIRCUIT/SYSTEM TESTING

### NOTE:

- Refer to the **EN 41413-A: EEST** operation manual for detailed instructions in **Evaporative Emission System Diagnosis** .
- Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.
- Ensure that the underbody temperature of the vehicle and the tester are similar.

1. Disconnect the purge tube at the quick connector on the evaporative emission canister side of the Q12 evaporative emission canister purge solenoid valve and install the **CH 48096:** Port Tool.
2. Connect the **EN 41413-A: EEST** to the **CH 48096:** Port Tool.
3. Using a scan tool close the evaporative emission canister vent solenoid valve to seal the evaporative emission system.
4. Use the flow meter on the **EN 41413-A: EEST**, calibrated to 0.51 mm (0.020 in) to determine that there is no leak in the evaporative emission system.
  - If a leak is detected, use the **EN 41413-A: EEST** to apply smoke to the evaporative emission system at the purge tube until the leak is located using the **EN 41413-SPT: White Light**.

## REPAIR VERIFICATION

1. Seal the EVAP system and use the flow meter on the **EN 41413-A: EEST**, calibrated to 0.51 mm (0.020 in) to determine that there is no leak in the EVAP system.
2. Clear DTCs.

## DTC P0443 OR P0449 (W/LF1, LFW)

## 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.

## DTC DESCRIPTORS

**DTC P0443**

Evaporative Emission (EVAP) Purge Solenoid Control Circuit

**DTC P0449**

Evaporative Emission (EVAP) Vent Solenoid Control Circuit

**DIAGNOSTIC FAULT INFORMATION**

| Circuit                           | Short to Ground | High Resistance | Open  | Short to Voltage | Signal Performance |
|-----------------------------------|-----------------|-----------------|-------|------------------|--------------------|
| Ignition 1 Voltage - Purge Supply | P0443           | P0443           | P0443 | -                | -                  |
| Battery Positive - Vent Supply    | P0449           | P0449           | P0449 | -                | -                  |
| EVAP Purge Solenoid Control       | P0443           | P0443           | P0443 | P0443            | -                  |
| EVAP Vent Solenoid Control        | P0449           | P0449           | P0449 | P0449            | -                  |

**CIRCUIT/SYSTEM DESCRIPTION**

An ignition voltage is supplied directly to the evaporative emission (EVAP) canister purge solenoid valve. The engine control module (ECM) grounds the EVAP canister purge solenoid valve control circuit through an internal switch called a driver. The ECM monitors the status of the driver. The EVAP canister purge solenoid valve is pulse width modulated (PWM). A scan tool will display the amount of ON time as a percentage.

Battery voltage is supplied to the EVAP canister solenoid valve. The ECM grounds the EVAP canister vent solenoid valve control circuit through an internal switch called a driver. The ECM monitors the status of the driver. A scan tool will display the commanded state of the EVAP canister vent solenoid valve as ON or OFF.

**CONDITIONS FOR RUNNING THE DTC**

- The ignition is ON.
- The system voltage is between 9-18 V.
- DTCs P0443 and P0449 run continuously when the above conditions are met.

**CONDITIONS FOR SETTING THE DTC**

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for a minimum of 5 s.

**ACTION TAKEN WHEN THE DTC SETS**

DTCs P0443 and P0449 are Type B DTCs.

**CONDITIONS FOR CLEARING THE MIL/DTC**

DTCs P0443 and P0449 are Type B DTCs.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Description and Operation

#### Evaporative Emission Control System Description

### Connector End View Reference

#### Component Connector End Views

### Electrical Information Reference

- Circuit Testing
- Troubleshooting with a Test Lamp
- 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

## CIRCUIT/SYSTEM VERIFICATION

### P0443

1. Ignition ON, engine OFF, you should hear a clicking sound when the EVAP canister purge solenoid valve is commanded to 50 % with a scan tool. The clicking sound should stop when the EVAP canister purge solenoid valve is commanded to 0 %. The rate at which the valve cycles should increase when the commanded state is increased, and decrease when the commanded state is decreased.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

### P0449

1. Ignition ON, engine OFF, command the EVAP vent solenoid ON and OFF with a scan tool.
2. Listen for a click when the valve operates. Verify that both the ON, and the OFF states are commanded.
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within

the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect the harness connector at the Q12 EVAP canister purge or Q13 vent solenoid valve.
2. Ignition ON, verify that a test lamp illuminates between the voltage supply circuit terminal A and ground.
  - If the test lamp does not illuminate, test the voltage supply circuit for a short to ground or an open/high resistance. If the circuit tests normal and the voltage supply circuit fuse is open, test or replace the EVAP canister purge solenoid.
3. Connect a test lamp between the voltage supply circuit terminal A and the control circuit terminal B.
4. Command the EVAP canister purge solenoid valve to 50 % with a scan tool, or the EVAP canister vent solenoid valve ON and OFF. The test lamp should respond to the command.
  - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
  - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, replace the appropriate solenoid valve.

## **REPAIR PROCEDURES**

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

- **Evaporative Emission Canister Purge Solenoid Valve Replacement (LF1)**
- **Evaporative Emission Canister Vent Solenoid Valve Replacement**
- **Control Module References** for ECM replacement, setup, and programming

## **DTC P0446**

### **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.

### **DTC DESCRIPTOR**

#### **DTC P0446**

Evaporative Emissions (EVAP) Vent System Performance

### **CIRCUIT/SYSTEM DESCRIPTION**

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path that would

cause excess amounts of vacuum to be developed in the EVAP system. With the purge valve open and the canister vent valve open, if the EVAP system vacuum goes above a calibrated threshold, the test will fail.

## TYPICAL SCAN TOOL DATA

| Fuel Tank Pressure Sensor Signal Voltage | Fuel Tank Pressure        |
|------------------------------------------|---------------------------|
| 1.5 V                                    | Atmospheric Pressure/BARO |
| Less than 1.5 V                          | Positive Pressure         |
| More than 1.5 V                          | Negative Pressure/Vacuum  |

## CONDITIONS FOR RUNNING THE DTC

- Before the ECM can report DTC P0446 failed, DTCs P0450, P0451, P0452, and P0453 must run and pass.
- DTC P0100, P0101, P0102, P0103, P0111, P0112, P0113, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0221, P0222, P0223, P0443, P0449, P0451, P0452, P0453, P0458, P0459, P0496, P0497, P0498, P0499, P0560, P0562, P0563, P0700, P2122, P2123, P2127, P2128 or P2138 is not set.
- The ignition voltage is 10-18 volts.
- The Closed Loop fuel control is enabled.
- The engine run time is greater than 10 minutes or the fuel trim is stable.
- The engine is idling.
- The Fuel Tank Pressure is between -18.7 and +9.8 mm Hg (-10.0 and +5.2 in. H<sub>2</sub>O).
- The ambient air temperature (AAT) is between 2-32°C (35-90°F).
- The ECT and the IAT are within 10°C (18°F) of each other at engine start-up.
- The barometric pressure (BARO) is greater than 68 kPa.
- The long term fuel trim remains steady, less than 3 percent change in 200 ms over a period of 8 seconds.
- The fuel level is between 11-88 percent.
- The vehicle speed sensor (VSS) is less than 3 km/h (2 mph).
- The above conditions exist for greater than 5 seconds.
- DTC P0446 will attempt to run up to 10 times or until the test completes successfully once per ignition cycle.

## CONDITIONS FOR SETTING THE DTC

- The Fuel Tank Pressure Sensor is less than -7.5 mm Hg (-4.0 in. H<sub>2</sub>O).
- The condition is exists for greater than 4 seconds or a cumulative of 30 seconds.

## ACTION TAKEN WHEN THE DTC SETS

DTC P0446 is a Type B DTC.

## CONDITIONS FOR CLEARING THE DTC

DTC P0446 is a Type B DTC.

## **DIAGNOSTIC AIDS**

An intermittent condition could be caused by a damaged EVAP vent housing, a temporary blockage at the EVAP vent valve inlet or a pinched vent hose. A blockage in the vent system may also cause a poor fuel fill problem.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Evaporative Emission Control System Description**

### **DTC Type Reference**

#### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

### **Scan Tool Reference**

#### **Control Module References** for scan tool information

## **CIRCUIT/SYSTEM VERIFICATION**

1. Ignition ON and fuel cap removed, verify that the Fuel Tank Pressure Sensor parameter is between 1.3-1.7 volts.
  - If not within the specified range, go to the fuel tank pressure sensor section in Circuit/System Testing.
2. Install the fuel cap.
3. With the engine running, the EVAP canister vent solenoid valve open, use a scan tool to command the EVAP canister purge solenoid valve to 100 percent. The fuel tank vacuum should not increase to more than -15 mmHg (-8 inches H<sub>2</sub>O).
  - If the fuel tank vacuum is greater than the specified range, go to the restriction section in Circuit/System Testing.
4. Using the scan tool, decrease the canister purge duty cycle from 100 percent to 0 percent. The vacuum should decrease to near zero.
  - If the fuel tank vacuum does not return to zero or appears to decrease too slowly go to the restriction section in Circuit/System Testing.

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

**IMPORTANT: Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.**

### **Restriction**

1. With the engine running, the EVAP canister vent solenoid valve open, and the EVAP canister purge solenoid valve commanded to 100 percent, the fuel tank vacuum should not increase to more than -15 mmHg (-8 inches H2O).
  - If the fuel tank vacuum is greater than the specified value, isolate the restriction by disconnecting one component at a time while the EVAP canister purge solenoid valve is commanded to 100 percent and the vent valve is open.
2. Using the scan tool, decrease the canister purge duty cycle from 100 percent to 0 percent. The vacuum should decrease to near zero.
  - If the fuel tank vacuum does not return to zero, or appears to decrease too slowly, inspect the components in the EVAP vent system for a restriction.

### **Fuel Tank Pressure Sensor**

1. Ignition OFF, disconnect the harness connector at the fuel tank pressure sensor.
2. Ignition OFF, test for less than 5 ohms between the low reference circuit terminal and ground.
  - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the fuel tank pressure sensor.

## **REPAIR PROCEDURES**

### **Evaporative Emission Canister Vent Solenoid Valve Replacement**

### **REPAIR VERIFICATION**

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

With the engine running, the EVAP canister vent solenoid valve open and the EVAP canister purge solenoid valve commanded to 100 %, the fuel tank vacuum should not increase to more than -15 mmHg (-8 inches H2O).

## **DTC P0451-P0454 (W/LF1, LFW)**

### **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.

## DTC DESCRIPTORS

### DTC P0451

Fuel Tank Pressure Sensor Performance

### DTC P0452

Fuel Tank Pressure Sensor Circuit Low Voltage

### DTC P0453

Fuel Tank Pressure Sensor Circuit High Voltage

### DTC P0454

Fuel Tank Pressure Sensor Intermittent

## DIAGNOSTIC FAULT INFORMATION

| Circuit                                 | Short to Ground     | High Resistance | Open         | Short to Voltage | Signal Performance |
|-----------------------------------------|---------------------|-----------------|--------------|------------------|--------------------|
| Fuel Tank Pressure Sensor 5V Reference  | P0452, P0532, P0641 | P0451           | P0446, P0452 | P0453, P0641     | -                  |
| Fuel Tank Pressure Sensor Signal        | P0452               | P0451           | P0452        | P0453            | P0451, P0454       |
| Fuel Tank Pressure Sensor Low Reference | -                   | P0446, P0451    | P0446        | -                | P0451              |

## TYPICAL SCAN TOOL DATA

### Fuel Tank Pressure Sensor Voltage

| Circuit                                              | Short to Ground | Open  | Short to Voltage |
|------------------------------------------------------|-----------------|-------|------------------|
| <b>Operating Conditions:</b> Ignition ON, Engine OFF |                 |       |                  |
| <b>Parameter Normal Range:</b> 1.3-1.7 V             |                 |       |                  |
| Fuel Tank Pressure Sensor 5V Reference               | 0 V             | 0 V   | 4.2-5 V          |
| Fuel Tank Pressure Sensor Signal                     | 0 V             | 0 V   | 5 V              |
| Fuel Tank Pressure Sensor Low Reference              | -               | 4.5 V | -                |

## CIRCUIT/SYSTEM DESCRIPTION

The fuel tank pressure sensor measures air pressure or vacuum in the evaporative emission (EVAP) system. The engine control module (ECM) supplies a 5V reference and a low reference circuit to the fuel tank pressure

sensor. The fuel tank pressure sensor signal voltage varies depending on EVAP system pressure or vacuum. The controller also uses this fuel tank pressure signal to determine atmospheric pressure for use in the engine-off small leak test, DTC P0442. Before using this signal as an atmospheric reference it must first be re-zeroed.

## **CONDITIONS FOR RUNNING THE DTC**

### **P0451**

- DTC P0451 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- The number of times this test runs can range from 0-2 per engine-off period. The length of the test can be up to 10 minutes.

### **P0452 and P0453**

DTC P0452 and P0453 run continuously when the ignition is ON.

### **P0454**

- DTC P0454 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- This test can run once per engine-off period. The length of the test can be up to 10 minutes.
- A refueling event is not detected.

## **CONDITIONS FOR SETTING THE DTC**

### **P0451**

This DTC will set if the controller is unable to re-zero the fuel tank pressure sensor voltage within a calibrated range during the engine-off small leak test, P0442.

### **P0452**

The fuel tank pressure sensor voltage is less than 0.1V for more than 5 seconds.

### **P0453**

The fuel tank pressure sensor voltage is more than 4.9V for more than 5 seconds.

### **P0454**

If, during the engine-off natural vacuum small leak test, P0442, the ECM detects an abrupt fuel tank pressure signal change, other than a refueling event, this DTC will set. An abrupt change is defined as a change of 0.45 inch H<sub>2</sub>O in the span of 1 second.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTCs P0451 and P0454 are Type A DTCs.
- DTCs P0452 and P0453 are Type B DTCs.

## CONDITIONS FOR CLEARING THE MIL/DTC

- DTCs P0451 and P0454 are Type A DTCs.
- DTCs P0452 and P0453 are Type B DTCs.

## DIAGNOSTIC AIDS

### P0451 and P0454

- A restriction in the EVAP canister or vent lines could prevent fuel vapor pressure from bleeding off fast enough. If the vent system cannot bleed off pressure fast enough, the re-zero procedure may not complete successfully, which could cause this code to set.
- Ensure that the reference port on the fuel tank pressure sensor is unobstructed.
- An fuel tank pressure sensor that is skewed or does not have a linear transition from low to high may cause this code to set. Scan tool output controls, snapshot, and plot functions can help detect erratic sensor response. To test the sensor signal under vacuum conditions, use the Quick Snapshot and the Purge/Seal functions to capture data while commanding purge to 20 percent, then plot the data to look for erratic sensor operation. A similar test can be done for the pressure side of the sensor operation by applying pressure with the **J 41413-200: EEST** while taking a snapshot.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End 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

## **J 41413-200: Evaporative Emission System Tester (EEST)**

### **CIRCUIT/SYSTEM VERIFICATION**

1. Remove the fuel cap.
2. Ignition ON, engine OFF.
3. Observe the Fuel Tank Pressure Sensor parameter with a scan tool.
4. The fuel tank pressure Sensor parameter should be 1.3-1.7 V.

### **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect the harness connector at the B150 fuel tank pressure sensor.
2. Ignition OFF, test for less than 5 ohms of resistance between the low reference circuit terminal and ground.
  - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2V between the 5V reference circuit terminal and ground.
  - If less than the specified range, test the 5V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
  - If greater than the specified range, test the 5V reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.
4. Verify the scan tool B150 fuel tank pressure sensor parameter is less than 0.2V.
  - If greater than the specified range, test the signal circuit terminal for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Install a 3A fused jumper wire between the signal circuit terminal and the 5V reference circuit terminal. Verify the scan tool fuel tank pressure sensor parameter is greater than 4.7V.
  - If less than the specified range, test the signal circuit for short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
6. If all circuits test normal, test or replace the B150 fuel tank pressure sensor.

### **REPAIR PROCEDURES**

- **Fuel Tank Pressure Sensor Replacement**
- For DTC P0452 or P0453, always perform the **Diagnostic Repair Verification** after completing the diagnostic procedure
- For DTC P0451 or P0454, clear DTCs with a scan tool
- **Control Module References** for ECM replacement, setup, and programming

### **DTC P0455 (W/LF1, LFW)**

### **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.

## **DTC DESCRIPTOR**

### **DTC P0455**

Evaporative Emission System Large Leak Detected

## **CIRCUIT/SYSTEM DESCRIPTION**

The ECM tests the Evaporative Emission (EVAP) System for a large leak or restrictions to the purge path in the EVAP system. When the enabling criteria has been met the ECM commands the evaporative emission canister vent solenoid valve ON and the evaporative emission canister purge solenoid valve ON, allowing vacuum into the evaporative emission system. The ECM monitors the fuel tank pressure sensor voltage to verify that the system is able to reach a predetermined level of vacuum within a set amount of time.

## **CONDITIONS FOR RUNNING THE DTC**

- Before the ECM can report DTC P0455 failed, DTC P0496 must run and pass.
- DTCs P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0442, P0443, P0449, P0451, P0452, P0453, P0454, P0464, P0496, P0608, P0609, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138 are not set.
- The ignition voltage is between 11-18 V.
- The barometric pressure (BARO) is more than 74 kPa.
- The fuel level is between 10-90 percent.
- The engine coolant temperature (ECT) at start-up is less than 35°C (95°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- DTC P0455 runs once per cold start when the above conditions are met.

## **CONDITIONS FOR SETTING THE DTC**

The evaporative emission system is not able to achieve or maintain a calibrated level of vacuum within a set amount of time.

## **ACTION TAKEN WHEN THE DTC SETS**

DTC P0455 is a Type B DTC.

## **CONDITIONS FOR CLEARING THE MIL/DTC**

DTC P0455 is a Type B DTC.

## **DIAGNOSTIC AIDS**

- Inspect for a loose, missing, damaged, or incorrect fuel fill cap.
- Inspect for a damaged fuel filler neck seal surface.
- A blockage or restriction in the evaporative emission purge solenoid valve, purge pipe, evaporative emission canister, or vapor pipe, can cause this DTC to set.
- The evaporative emission system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. Close the system once smoke is observed.
- To help locate intermittent leaks using the **J 41413-200: EEST**, move all evaporative emission components while observing smoke with the **J 41413-SPT: White Light**.
- Individual components can be isolated and tested using adapters in the **J 41413-300: Kit**.
- A condition may exist where a leak in the evaporative emission system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a vacuum in the evaporative emission system and then observe the fuel tank pressure parameter for vacuum decay.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Evaporative Emission Control System Description**

### **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**

- **CH 48096:** Evaporative Emissions Service Access Port Tool
- **J 41415-30:** Fuel Tank Adapter
- **J 41413-200:** Evaporative Emissions System Tester (EEST)
- **J 41413-300:** Evaporative Emissions Cap and Plug Kit
- **J 41413-311:** Evaporative Emissions Plug
- **J 41413-SPT:** High Intensity White Light
- **J 41413-VLV:** Evaporative Emissions Service Port Vent Tool
- For equivalent regional tools, refer to **Special Tools** .

## CIRCUIT/SYSTEM TESTING

### NOTE:

- **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.**
- **Refer to the J 41413-200: EEST operation manual for detailed instructions in Evaporative Emission System Diagnosis .**

1. Disconnect the purge tube at the quick connector on the evaporative emission canister side of the Q12 evaporative emission canister purge solenoid valve. Install the **CH 48096:** Port Tool between the disconnected purge tube and the purge solenoid valve. Connect the **J 41413-200:** EEST to the service access port tool.
2. Use a scan tool to seal the evaporative emission system.
3. Use the flow meter on the **J 41413-200:** EEST, calibrated to 0.51 millimeter (0.020 inch) to determine that there is no leak in the evaporative emission system.
  - If a leak is detected, use the **J 41413-200:** EEST to apply smoke to the evaporative emission system at the purge tube until the leak is located using the **J 41413-SPT:** White Light.
4. To test for a restriction, install the **J 41415-30:** Adapter to the fuel tank filler neck. Connect the **J 41413-200:** EEST to the adapter.
5. Allow the engine to idle.
6. Use the Purge/Seal function to seal the system with a scan tool.
7. Command the EVAP Purge Solenoid Valve to 30 percent.
8. The vacuum/pressure gauge on the **J 41413-200:** EEST and the fuel tank pressure parameter on the scan tool should both show vacuum.
  - If the vacuum/pressure gauge shows vacuum, but the fuel tank pressure parameter does not show vacuum, replace the fuel tank pressure sensor.
  - If neither the fuel tank pressure parameter nor the vacuum/pressure gauge shows vacuum, repair the restriction in the purge path.
9. Verify that the vacuum increases to the abort limit on the scan tool or more than 3.2 V, and the values are similar between the scan tool and the vacuum/pressure gauge on the **J 41413-200:** EEST.
  - If the values are not similar, or the voltage did not reach 3.2 V, replace the B150 fuel tank pressure sensor.

REPAIR PROCEDURES

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Fuel Tank Pressure Sensor Replacement

DTC P0496

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.

DTC DESCRIPTOR

DTC P0496

Evaporative Emissions (EVAP) System Flow During Non-Purge

CIRCUIT DESCRIPTION

This DTC tests for continuous intake manifold vacuum flow to the Evaporative Emission (EVAP) System. The control module seals the EVAP system by commanding the EVAP canister purge solenoid valve Closed and the EVAP canister vent solenoid valve Closed. The control module monitors the fuel tank pressure (FTP) sensor to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is greater than a predetermined value within a predetermined time, this DTC sets.

| FTP Sensor Signal Voltage             | Fuel Tank Pressure       |
|---------------------------------------|--------------------------|
| High, Approximately 1.5 Volts or More | Negative Pressure/Vacuum |
| Low, Approximately 1.5 Volts or Less  | Positive Pressure        |

Conditions for Running the DTC

- Before the engine control module (ECM) can report DTC P0496 failed, DTCs P0450, P0451, P0452, and P0453 must run and pass.
- DTC P0100, P0101, P0102, P0103, P0111, P0112, P0113, P0116, P0117, P0118, P0119, P0443, P0446, P0449, P0450, P0451, P0452, P0453, P0458, P0459, P0498, P0499, P0560, P0562, P0563, P0700, P2122, P2123, P2127, P2128, P2138, P2227, P2228, or P2229 is not set.
- The fuel system is in closed loop.
- The engine run time is greater than 10 minutes, or the long term fuel trim is stable.
- The vehicle speed sensor (VSS) is less than 3 km/h (2 mph).
- The engine is idling.
- The ignition voltage is between 10-18 volts.

- The Closed Loop fuel control is enabled.
- The fuel tank pressure (FTP) is between -10.0 and +5.0 in. H<sub>2</sub>O (-18.7 and +9.8 mm Hg).
- The ambient air temperature is between 2-32°C (36-90°F).
- The start-up engine coolant temperature (ECT) is within 10°C (18°F) of ambient air temperature
- The fuel tank level is between 11-88 percent.
- The barometric pressure (BARO) is greater than 68 kPa.
- The above conditions are met for greater than 30 seconds.
- DTC P0496 will attempt to run up to 10 times or the test completes successfully once per ignition cycle.

## **CONDITIONS FOR SETTING THE DTC**

- The control module detects vacuum during a non-purge condition.
- The condition exists for greater than 4 seconds or for a cumulative of 30 seconds.

## **ACTION TAKEN WHEN THE DTC SETS**

DTC P0496 is a Type A/B DTC.

## **CONDITIONS FOR CLEARING THE DTC**

DTC P0496 is a Type A/B DTC.

## **DIAGNOSTIC AIDS**

- Observe the Freeze Frame/Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition occurs that caused the DTC to set. This may assist in diagnosing the condition.
- The EVAP system tests run when engine is first started and meets The Conditions for Running the DTC. An intermittent condition could be caused by an improperly installed or damaged EVAP canister purge solenoid valve, or by a temporary blockage or restriction in the EVAP canister purge solenoid valve.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Evaporative Emission Control System Description**

## DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

## Scan Tool Reference

Control Module References for scan tool information

## CIRCUIT/SYSTEM TESTING

1. Disconnect the Q12 EVAP purge solenoid valve electrical harness connector.
2. Start the engine.
3. Command the Q13 EVAP vent solenoid valve Closed with a scan tool.
4. Increase the engine speed to 1,200-1,500 RPM.
5. Observe the scan tool fuel tank pressure (FTP) sensor parameter. Verify the scan tool FTP sensor parameter is -0.9 to +0.9 mm Hg (-0.5 to +0.5 in. H<sub>2</sub>O).
  - If not within the specified range, replace the Q12 EVAP purge solenoid valve.
6. Ignition ON, engine OFF, disconnect the EVAP purge hose/pipe at the Q12 EVAP purge solenoid valve.
7. Observe the scan tool FTP sensor parameter. Verify the FTP sensor parameter is -0.9 to +0.9 mm Hg (-0.5 to +0.5 in. H<sub>2</sub>O).
  - If not within the specified range, replace the B150 FTP sensor.

## REPAIR PROCEDURES

- Evaporative Emission Canister Purge Solenoid Valve Replacement (LF1)
- Fuel Tank Pressure Sensor Replacement
- Control Module References for engine control module replacement, setup, and programming

## REPAIR VERIFICATION

1. Start the engine.
2. Command the Q13 EVAP vent solenoid valve Closed with a scan tool.
3. Increase the engine idle to 1,200-1,500 RPM.
4. Observe the scan tool FTP sensor parameter. Verify the FTP sensor parameter is -0.9 to +0.9 mm Hg (-0.5 to +0.5 in. H<sub>2</sub>O).
5. Clear the DTCs with a scan tool.

## DTC P0506 OR P0507 (LF1, LFW)

## 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.

## **DTC DESCRIPTORS**

### **DTC P0506**

Idle Speed Low

### **DTC P0507**

Idle Speed High

## **CIRCUIT/SYSTEM DESCRIPTION**

The throttle actuator control (TAC) motor is a DC motor that is part of the throttle body assembly. The TAC motor drives the throttle valve. The engine control module (ECM) controls the TAC motor based on throttle position sensor input. The idle speed is controlled by the ECM based on various inputs. The ECM commands the TAC motor to open or close the throttle valve in order to maintain the desired idle speed.

## **CONDITIONS FOR RUNNING THE DTC**

- DTCs P0068, P0101, P0102, P0103, P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0300-P0306, P0351-P0356, P0461-P0464, P0496, P0627, P0628, P0629, P0722, P1516, P2066-P2068, are not set.
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine coolant temperature (ECT) is greater than 60°C (140°F).
- The engine run time is greater than 60 seconds.
- The ignition voltage is between 11-18 volts.
- The transmission is not changing gears.
- The torque converter clutch (TCC) is not changing states.
- The intake air temperature (IAT) is warmer than -20°C (-4°F).
- The vehicle speed is less than 3 km/h (2 mph).
- The commanded RPM is steady within 25 RPM.
- The engine is idling for greater than 5 seconds.
- The DTCs run when the above conditions are met.

## **CONDITIONS FOR SETTING THE DTC**

### **P0506**

The actual engine speed is 94 RPM less than the desired idle speed for 10 seconds.

### **P0507**

The actual engine speed is 188 RPM greater than the desired idle speed for 10 seconds.

## **ACTION TAKEN WHEN THE DTC SETS**

DTCs P0506 and P0507 are Type B DTCs.

## **CONDITIONS FOR CLEARING THE DTC**

DTCs P0506 and P0507 are Type B DTCs.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End 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

## **CIRCUIT/SYSTEM VERIFICATION**

1. Ignition ON, observe the DTC information with a scan tool. Verify there are no other DTCs set.
  - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
2. Idle the engine at the normal operating temperature. Compare the Desired Idle Speed to the actual Engine Speed with a scan tool. The actual Engine Speed should not be less than 100 RPM of the Desired Idle Speed or 200 RPM greater than the Desired Idle Speed.
3. Allow the engine to idle within the Conditions for Running the DTC. DTCs P0506 or P0507 should not set.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You

may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

Verify none of the following conditions exist:

### **P0506**

- Excess deposits in the Q38 throttle body. Refer to **Throttle Body Inspection and Cleaning** .
- Restricted exhaust
- Mechanical conditions that limits engine speed
- Parasitic load on the engine-For example, a transmission condition, a belt driven accessory condition.
  - If a condition is found, repair as necessary.

### **P0507**

- Vacuum leaks
- A throttle valve that does not close correctly
- Verify the correct operation of the crankcase ventilation system. Inspect for the following conditions:
  - The routing of the positive crankcase ventilation (PCV) system
  - Vacuum leaks in the PCV system-Refer to **Crankcase Ventilation System Inspection/Diagnosis** .
- If a condition is found, repair as necessary.

## **REPAIR PROCEDURES**

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

### **Throttle Body Assembly Replacement (LF1)**

## **DTC P050D**

### **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.

### **DTC DESCRIPTOR**

### **DTC P050D**

Cold Start Rough Idle

## **CIRCUIT/SYSTEM DESCRIPTION**

During a cold start, the engine control module (ECM) commands dual-pulse mode during Open Loop operation to improve cold start emissions. In dual-pulse mode, the injectors are energized twice during each injection event. As with misfire diagnosis, in dual-pulse mode the ECM monitors the crankshaft position sensor and the camshaft position sensors to calculate crankshaft rotation speed. In normal operation, optimum fuel delivery during dual-pulse mode produces a steady crankshaft rotation speed. If the variations exceed a calibrated value, the code will be set.

## **CONDITIONS FOR RUNNING THE DTC**

- DTCs P0010, P0011, P0013, P0014, P0016, P0017, P0018, P0019, P0020, P0021, P0023, P0024, P0089, P0090-P0092, P00C6, P00C8, P00C9, P00CA, P0101-P0103, P0106-P0108, P0112-P0114, P0116-P0118, P0121-P0123, P0128, P0192, P0193, P0201-P0206, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0315, P0335, P0336, P0351-P0356, P0627-P0629, P069E, P0716, P0717, P0722, P0723, P0850-P0852, P1248, P1249, P124A, P124B, P124C, P124D, P1258, P135A, P135B, P150C, P163A, P1762, P1763, P1915, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P228C, P228D, U0109 are not set.
- The catalyst temperature is less than 100°C (212°F).
- The engine coolant temperature is warmer than 10°C (14°F).
- The barometric pressure is greater than 70 kPa.
- The engine speed is between 450-1800 RPM.
- The engine is running and a cold start has been detected.
- DTC P050D runs once per cold start.

## **CONDITIONS FOR SETTING THE DTC**

This DTC will set if the ECM detects variations in crankshaft rotation speed caused by the lack of adequate fuel delivery during dual-pulse mode.

## **ACTION TAKEN WHEN THE DTC SETS**

- DTC P050D is a Type B DTC.
- The ECM disables dual pulse mode and energizes the fuel injector as it would for a warm engine.

## **CONDITIONS FOR CLEARING THE DTC**

DTC P050D is a Type B DTC.

## **DIAGNOSTIC AIDS**

- This DTC may be set with a misfire DTC, however the existence of this DTC is a higher priority and indicates the condition to diagnose is related to fuel and/or injectors, not the ignition/spark system.
- A restricted fuel injector may cause this DTC to set.

- High resistance in the circuits of the injectors could set this DTC without setting an injector DTC. Test the injector circuits of the affected cylinders for a high resistance if you suspect a condition.
- A drop in system voltage during cold start may set this DTC.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End 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

## CIRCUIT/SYSTEM TESTING

**NOTE:**        **Circuit/System Testing requires cold start. Do not start vehicle prior to connecting scan tool and preparing to evaluate the condition during engine crank.**

1. Start the engine and observe the Cylinder 1-4 Current Misfire Counters during the first 500 engine cycles. The Cylinder 1-4 Current Misfire Counters should not be incrementing.
  - If the misfire counters are incrementing on one or more cylinders, verify that the following conditions do not exist:
    - Fuel pressure that is too low or too high-Refer to **Fuel System Diagnosis** .
    - Contaminated fuel-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
2. If all conditions test normal, replace fuel injectors as indicated by high misfire counts.

## REPAIR PROCEDURES

- **Fuel Injection Fuel Rail Assembly Replacement - Bank 1 (LF1)**
- **Fuel Injection Fuel Rail Assembly Replacement - Bank 2 (LF1)**

## REPAIR VERIFICATION

**NOTE:**        **Repair Verification requires cold start.**

1. Ignition ON, engine OFF, clear the DTCs with a scan tool.
2. Start the engine.
3. Verify the DTC does not reset.

## **DTC P0601-P0604, P0606, P0607, P0610, P062B, P062F, P0630, P16F3, OR P2610 (LF1, LFW, LWR)**

### 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.

### DTC DESCRIPTORS

#### **DTC P0601**

Control Module Read Only Memory Performance

#### **DTC P0602**

Control Module Not Programmed

#### **DTC P0603**

Control Module Long Term Memory Reset

#### **DTC P0604**

Control Module Random Access Memory Performance

#### **DTC P0606**

Control Module Processor Performance

#### **DTC P062B**

Control Module Fuel Injector Control Performance

## **DTC P062F**

Control Module Long Term Memory Performance

## **DTC P0630**

VIN Not Programmed or Mismatched - Engine Control Module (ECM)

## **DTC P16F3**

Control Module Redundant Memory Performance

## **DTC P2610**

Control Module Ignition Off Timer Performance

## **CIRCUIT/SYSTEM DESCRIPTION**

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). This diagnostic also addresses if the ECM is not programmed, or is programmed incorrectly.

## **CONDITIONS FOR RUNNING THE DTC**

### **P0601, P062B, P0630, P16F3**

These DTCs run continuously when the ignition is ON.

### **P0602, P0603, P062F**

These DTCs run at power up.

### **P0604**

DTC P0604 runs continuously when the ignition is ON. First memory scan may take up to 30 s.

### **P0606**

- System voltage is greater than 6 V.
- Reduced engine power is not active.
- DTC P0606 runs continuously when the above conditions are met.

### **P2610**

- The intake air temperature is between -40 to +80°C (-40 to +176°F).
- DTCs P0111, P0112, P0113 are not set.
- DTC P2610 runs on ECM power down.

## CONDITIONS FOR SETTING THE DTC

The ECM detects an internal failure or incomplete or incorrect programming.

## ACTION TAKEN WHEN THE DTC SETS

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P062F, P0630 and P16F3 are Type A DTCs.
- DTC P2610 is a Type B DTC.

## CONDITIONS FOR CLEARING THE DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P062F, P0630 and P16F3 are Type A DTCs.
- DTC P2610 is a Type B DTC.

## DIAGNOSTIC AIDS

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify for the following:

- The battery cables are clean and tight, and the battery is fully charged-Refer to **Battery Inspection/Test** .
- The ECM ground circuits do not have an open or high resistance
- The ECM power circuits do not have an open, short to ground, or high resistance

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End 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

## **CIRCUIT/SYSTEM VERIFICATION**

1. Observe the DTC information with a scan tool. DTC P0601, P0602, P0603, P0604, P0606, P062B, P062F, P0630, P16F3, or P2610 should not set.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## **CIRCUIT/SYSTEM TESTING**

1. Ignition ON, observe the DTC information with a scan tool.
  - If DTC P0602 or P0630 failed this ignition, program the K20 ECM. If the DTC resets, replace the K20 ECM.
2. Observe the DTC information with a scan tool. DTC P0601, P0603, P0604, P0606, P062B, P062F, P16F3, or P2610 should not set.
  - If a DTC failed this ignition, replace the K20 ECM.

## **REPAIR PROCEDURES**

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

**Control Module References** for engine control module replacement, setup, and programming

## **DTC P0601-P0604, P0606, OR P062F**

### **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.

### **DTC DESCRIPTORS**

#### **DTC P0601**

Control Module Read Only Memory (ROM)

#### **DTC P0602**

Control Module Not Programmed

#### **DTC P0603**

Control Module Long Term Memory Reset

## **DTC P0604**

Control Module Random Access Memory (RAM)

## **DTC P0606**

Control Module Internal Performance

## **DTC P062F**

Control Module Long Term Memory Performance

## **CIRCUIT/SYSTEM DESCRIPTION**

The internal fault detection is handled inside the fuel pump control module. No external circuits are involved.

## **CONDITIONS FOR RUNNING THE DTC**

The fuel pump control module runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

## **CONDITIONS FOR SETTING THE DTC**

The fuel pump control module has detected an internal malfunction.

## **ACTION TAKEN WHEN THE DTC SETS**

DTC P0601, P0602, P0603, P0604, P0606 and P062F are type A DTCs.

## **CONDITIONS FOR CLEARING THE DTC**

DTC P0601, P0602, P0603, P0604, P0606 and P062F are type A DTCs.

## **REFERENCE INFORMATION**

### **Description and Operation**

### **Fuel System Description (LF1)**

### **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**

#### **CIRCUIT/SYSTEM VERIFICATION**

**NOTE:** This DTC may be stored as a history DTC without affecting the operation of the module. If stored only as a history DTC and not retrieved as a current DTC, do not replace the module.

Verify that DTC P0602 is not set.

- If the DTC is set, program the K27 fuel pump control module.

Verify that DTCs P0601, P0603, P0604, P0606, and P062F are not set.

- If the DTCs are set, program the K27 fuel pump control module. If the DTCs reset, replace the K27 fuel pump control module.

#### **REPAIR PROCEDURES**

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

**Control Module References** for fuel pump control module replacement, setup, and programming

## **DTC P0627-P0629**

#### **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.

#### **DTC DESCRIPTORS**

##### **DTC P0627**

Fuel Pump Enable Circuit

##### **DTC P0628**

Fuel Pump Enable Circuit Low Voltage

##### **DTC P0629**

## Fuel Pump Enable Circuit High Voltage

### DIAGNOSTIC FAULT INFORMATION

| Circuit          | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|------------------|-----------------|----------------------|------------------|--------------------|
| Fuel Pump Enable | P0628, P069E    | P0627, P069E         | P0629            | -                  |

### CIRCUIT/SYSTEM DESCRIPTION

The engine control module (ECM) provides ignition voltage to the fuel pump flow control module whenever the engine is cranking or running. The control module enables the fuel pump flow control module as long as the engine is cranking or running, and ignition system reference pulses are received. While this enable voltage is being received, the fuel pump flow control module supplies a varying voltage to the in-tank fuel pump module in order to maintain the desired fuel line pressure.

### CONDITIONS FOR RUNNING THE DTC

- The engine speed is greater than 0 RPM.
- The ignition voltage is between 11-18 V.
- The DTCs run continuously when the conditions above are met.

### CONDITIONS FOR SETTING THE DTC

- The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above condition is met for a minimum of 2.5 s.

### ACTION TAKEN WHEN THE DTC SETS

DTCs P0627, P0628, and P0629 are Type B DTCs.

### CONDITIONS FOR CLEARING THE DTC

DTCs P0627, P0628, and P0629 are Type B DTCs.

### REFERENCE INFORMATION

#### Schematic Reference

#### Engine Controls Schematics

#### Connector End View Reference

#### Component Connector End 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

## CIRCUIT/SYSTEM VERIFICATION

1. Attempt to start the engine. Observe the DTC information with a scan tool. DTC P0627, P0628, or P0629 should not set.
2. Ignition ON, command the ECM Fuel Pump Enable ON and OFF with a scan tool while observing the following control circuit status parameters:
  - Fuel Pump Enable Circuit Low Voltage Test Status
  - Fuel Pump Enable Circuit Open Test Status
  - Fuel Pump Enable Circuit High Voltage Test Status

Each parameter should toggle between OK and Not Run or Not Run and OK.

3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the K27 fuel pump control module harness connector.
2. Connect a test lamp between the enable circuit terminal 20 of the fuel pump control module and ground.
3. Ignition ON, command the ECM Fuel Pump Enable ON and OFF with a scan tool. The test lamp should turn ON and OFF as commanded.
  - If the test lamp remains OFF all the time, test for a short to ground or an open/high resistance on the enable circuit. If circuit/connections test normal, replace the K20 ECM.
  - If the test lamp remains ON all the time, test for a short to voltage on the enable circuit. If circuit/connections test normal, replace the K20 ECM.
4. Ignition ON, test for 2-3 V on the enable circuit terminal 20 of the fuel pump control module.
  - If not within the specified range, replace the K20 ECM.
5. If all circuits/connections test normal, replace the K27 fuel pump control module.

REPAIR PROCEDURES

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM or fuel pump control module replacement, setup, and programming

DTC P0641 OR P06A6

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.

DTC DESCRIPTORS

DTC P0641

5 V Reference Circuit

DTC P06A6

5 V Reference Performance

DIAGNOSTIC FAULT INFORMATION

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference | P0641           | P0641, P06A6         | P0641            | P06A6              |
| Signal        | P018C           | P018B, P018C         | P018D            | P018B              |
| Low Reference | -               | P0641, P06A6         | -                | P06A6              |

CIRCUIT/SYSTEM DESCRIPTION

The fuel pressure sensor is located on the fuel line. The fuel pressure sensor monitors the fuel pressure in the fuel line. The fuel pump control module monitors the voltage signal from the fuel pressure sensor.

CONDITIONS FOR RUNNING THE DTC

The ignition is ON.

CONDITIONS FOR SETTING THE DTC

The fuel pump control module detects that the fuel pressure 5 V reference is above or below a predetermined voltage threshold.

## **ACTION TAKEN WHEN THE DTC SETS**

DTCs P0641 and P06A6 are Type A DTCs.

## **CONDITIONS FOR CLEARING THE DTC**

DTCs P0641 and P06A6 are Type A DTCs.

## **DIAGNOSTIC AIDS**

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End Views**

### **Description and Operation**

#### **Fuel System Description (LF1)**

### **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

## **CIRCUIT/SYSTEM TESTING**

1. Ignition OFF, disconnect harness connector of the B47 fuel pressure sensor.

2. Ignition OFF, test for less than 1.0 ohms between the low reference circuit terminal 2 and ground.
  - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K27 fuel pump control module.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
  - If less than the specified range, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K27 fuel pump control module.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K27 fuel pump control module.
4. If all circuits test normal, replace the B47 fuel pressure sensor.

## REPAIR PROCEDURES

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

**Control Module References** for fuel pump control module replacement, setup, and programming

## DTC P0641, P0651, P0697, OR P06A3 (ECM)

### 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.

### DTC DESCRIPTORS

#### DTC P0641

5 V Reference 1 Circuit

#### DTC P0651

5 V Reference 2 Circuit

#### DTC P0697

5 V Reference 3 Circuit

#### DTC P06A3

5 V Reference 4 Circuit

### CIRCUIT/SYSTEM DESCRIPTION

The engine control module (ECM) has 4 5 V reference buses called 5 V reference 1, 5 V reference 2, 5 V

reference 3, and 5 V reference 4. Each reference bus provides a 5 V reference for more than one sensor. A short to ground or voltage on one of the 5 V reference circuits can affect all the components connected to that 5 V reference bus. The ECM monitors the voltage on the 5 V reference buses.

## **CONDITIONS FOR RUNNING THE DTC**

DTCs P0641, P0651, P0697, P06A3 run continuously when the ignition is ON.

## **CONDITIONS FOR SETTING THE DTC**

The 5 V reference circuit voltage is greater or less than a predetermined threshold.

## **ACTION TAKEN WHEN THE DTC SETS**

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

## **CONDITIONS FOR CLEARING THE DTC**

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

## **DIAGNOSTIC AIDS**

### **P0641**

The 5 V reference 1 bus provides 5 V to the following sensors:

- B150 fuel tank pressure (FTP) sensor
- B17 barometric pressure (BARO) sensor, throttle inlet absolute pressure sensor
- B47B fuel rail pressure (FRP) sensor
- B1 A/C refrigerant pressure sensor
- All four B23 camshaft position sensors

### **P0651**

The 5 V reference 2 bus provides 5 V to the following components:

- B26 crankshaft position sensor
- S87 economy mode switch

### **P0697**

The 5 V reference 3 bus provides 5 V to the following sensors:

- B74 manifold absolute pressure (MAP) sensor
- B107 accelerator pedal position sensor 2

## **P06A3**

The 5 V reference 4 bus provides 5 V to the following sensors:

- B106 throttle position sensor
- B107 accelerator pedal position sensor 1
  - It may be possible to locate the fault by disconnecting one component at a time from the affected 5 V reference bus while viewing the 5 V Reference Circuit Status parameter on the scan tool. The scan tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all components have been disconnected from the affected 5 V reference bus and a fault is still indicated, the fault may exist in the wiring harness.

## **REFERENCE INFORMATION**

### **Schematic Reference**

#### **Engine Controls Schematics**

### **Connector End View Reference**

#### **Component Connector End 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

## **CIRCUIT/SYSTEM VERIFICATION**

1. Ignition ON, observe the DTC information with a scan tool. DTC P0641, P0651, P0697, or P06A3 should not set.
2. Observe the appropriate scan tool 5 V Reference Circuit Test Status parameter. The parameter should display OK.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

**NOTE:** Additional DTCs will set when disconnecting the components.

1. Ignition OFF, disconnect the harness connector of all appropriate sensors for the applicable DTC. Refer to Diagnostic Aids.
2. Ignition ON, test for 4.8-5.2 V between one of the affected 5 V reference circuits and ground.
  - If the voltage is less than the specified range, test for a short to ground on the 5 V reference circuit for each affected component. If all circuits test normal, replace the K20 ECM.
  - If the voltage is greater than the specified range, test for a short to voltage on the 5 V reference circuit for each affected component. If all circuits test normal, replace the K20 ECM.

**NOTE:** A short to voltage on the signal circuit of certain components may cause this DTC to set.

3. Connect each component associated with the affected 5 V reference circuit one at a time while monitoring the appropriate scan tool 5 V Reference Voltage parameter. Verify the voltage remains 4.8-5.2 V.
  - If not the specified range when a component is connected, test the signal circuit of that component for a short to voltage. If the circuit tests normal, replace the component.

## REPAIR PROCEDURES

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Fuel Tank Pressure Sensor Replacement
- Throttle Inlet Absolute Pressure Sensor Replacement
- Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail (LF1)
- Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake
- Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust
- Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake
- Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust
- Accelerator Pedal Position Sensor Replacement
- Throttle Body Assembly Replacement (LF1)
- Crankshaft Position Sensor Replacement
- Air Conditioning Refrigerant Pressure Sensor Valve Replacement (LAF) or Air Conditioning Refrigerant Pressure Sensor Valve Replacement (LF1)
- Manifold Absolute Pressure Sensor Replacement
- Control Module References for engine control module replacement, setup, and programming

## DTC P0650

## 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.

**DTC DESCRIPTOR**

**DTC P0650**

Malfunction Indicator Lamp (MIL) Control Circuit

**DIAGNOSTIC FAULT INFORMATION**

| Circuit              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------|-----------------|----------------------|------------------|--------------------|
| MIL Voltage Supply   | P0650           | P0650                | -                | -                  |
| MIL Control          | P0650*          | P0650                | P0650            | -                  |
| * The MIL remains ON |                 |                      |                  |                    |

**CIRCUIT/SYSTEM DESCRIPTION**

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service. The engine control module (ECM) monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the ECM detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON.

**CONDITIONS FOR RUNNING THE DTC**

- The engine speed is greater than 80 RPM.
- The ignition voltage is between 10-18 V.
- The ECM has commanded the MIL ON and OFF at least once during the ignition cycle.
- DTC P0650 runs continuously when the above conditions are met.

**CONDITIONS FOR SETTING THE DTC**

The ECM detects an open, a short to ground, or a short to voltage on the circuit that controls the MIL.

**ACTION TAKEN WHEN THE DTC SETS**

DTC P0650 is a Type B DTC.

**CONDITIONS FOR CLEARING THE DTC**

DTC P0650 is a Type B DTC.

## DIAGNOSTIC AIDS

If the condition is intermittent, move the related harnesses and connectors with the engine operating. Monitor the scan tool Circuit Test Status parameters for the component. The Circuit Test Status parameter will change from OK or Not Run to Fault if there is a condition with the circuit or a connection.

## REFERENCE INFORMATION

### Schematic Reference

#### Engine Controls Schematics

### Connector End View Reference

#### Component Connector End 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

## CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON, command the MIL ON and OFF with a scan tool. The MIL should turn ON and OFF as commanded.
2. Ignition ON, observe each of the MIL Control Circuit Test parameters listed below 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

Each parameter should display OK or Not Run.

3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the harness connector at the P16 instrument cluster.
2. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal X1 31 and ground.
  - o If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the ignition circuit fuse is open, replace the P16 instrument cluster.
3. Connect a test lamp between the control circuit terminal X1 25 and the ignition circuit terminal X1 31.
4. Command the MIL ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
  - o If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
  - o If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, replace the P16 instrument cluster.

REPAIR PROCEDURES

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Instrument Cluster Replacement (Equinox) or Instrument Cluster Replacement (Terrain)
- Control Module References for engine control module replacement, setup, and programming

DTC P0685 OR P0690

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.

DTC DESCRIPTORS

DTC P0685

Engine Controls Ignition Relay Control Circuit

DTC P0690

Engine Controls Ignition Relay Feedback Circuit High Voltage

DIAGNOSTIC FAULT INFORMATION

|  |          |           |          |        |
|--|----------|-----------|----------|--------|
|  | Short to | Open/High | Short to | Signal |
|--|----------|-----------|----------|--------|

| Circuit                       | Ground | Resistance   | Voltage                    | Performance |
|-------------------------------|--------|--------------|----------------------------|-------------|
| Battery Supply Voltage - Coil | P0685  | P0685        | -                          | -           |
| Relay Control Circuit         | P0685  | P0685, P1682 | P0685, P0690, P1682, P2101 | -           |
| Relay Feedback Circuit        | -      | -            | P0690                      | -           |

## TYPICAL SCAN TOOL DATA

### Engine Controls Ignition Relay Control Circuit Low Voltage, Open, and High Voltage Test Status-Component Commanded OFF

| Circuit                                                                                                                                                                                                                                                                                                                                                                                         | Short to Ground | Open        | Short to Voltage |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|------------------|
| <b>Operating Conditions:</b> Component commanded OFF<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"> <li>• Component OFF-OK for Open/Short Gnd test and Not Run for Short To Volts test</li> <li>• Component ON-Not Run for Open/Short Gnd test and OK for Short To Volts test</li> </ul> |                 |             |                  |
| Battery Voltage                                                                                                                                                                                                                                                                                                                                                                                 | Malfunction     | Malfunction | -                |
| Engine Controls Ignition Relay Control Circuit                                                                                                                                                                                                                                                                                                                                                  | Malfunction     | Malfunction | Not Run          |

### Engine Controls Ignition Relay Control Circuit Low Voltage, Open, and High Voltage Test Status-Component Commanded ON

| Circuit                                                                                                                                                                                                                                                                                                                                                                                        | Short to Ground | Open    | Short to Voltage |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------|------------------|
| <b>Operating Conditions:</b> Component commanded ON<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"> <li>• Component OFF-OK for Open/Short Gnd test and Not Run for Short To Volts test</li> <li>• Component ON-Not Run for Open/Short Gnd test and OK for Short To Volts test</li> </ul> |                 |         |                  |
| Battery Voltage                                                                                                                                                                                                                                                                                                                                                                                | Not Run         | Not Run | -                |
| Engine Controls Ignition Relay Control Circuit                                                                                                                                                                                                                                                                                                                                                 | Not Run         | Not Run | Malfunction      |

## CIRCUIT/SYSTEM DESCRIPTION

The engine controls ignition relay or engine control module relay is a normally open relay. The relay switch is held in the open position by spring tension. Battery positive voltage is supplied directly to the relay coil and the switch contact at all times. The engine control module (ECM) supplies the ground path to the relay coil control circuit via an internal integrated circuit called an output driver. When the ECM commands the engine control module relay ON, ignition voltage is supplied to several fuses in the under-hood fuse block.

The ignition voltage that is supplied to the ECM provides power to the internal ECM circuits associated with the throttle actuator control (TAC) operation. The ECM also monitors the voltage level on the ignition voltage circuit to confirm that the engine control module relay contacts have closed.

## CONDITIONS FOR RUNNING THE DTC

- The ignition is ON.
- The ignition voltage is between 11-18 V.
- The DTC runs continuously when the above conditions are met.

## CONDITIONS FOR SETTING THE DTC

### P0685

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 2 s.

### P0690

- The ECM detects the engine controls ignition relay feedback circuit is greater than 2 V when the relay is commanded OFF.
- The ECM detects the engine controls ignition relay feedback circuit is greater than 18 V when the relay is commanded ON.
- The condition is present for greater than 2 s.

## ACTION TAKEN WHEN THE DTC SETS

DTCs P0685 and P0690 are Type B DTCs.

## CONDITIONS FOR CLEARING THE DTC

DTCs P0685 and P0690 are Type B DTCs.

## REFERENCE INFORMATION

### Schematic Reference

- Engine Controls Schematics
- Power Distribution Schematics

### Connector End View Reference

### Component Connector End Views

### Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Electrical Center Identification Views

- Probing Electrical Connectors
- 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

## CIRCUIT/SYSTEM VERIFICATION

### NOTE:

- A short to voltage on other components may cause DTC P0690 to set. If other DTCs are set, diagnose those DTCs first.
- If you were sent here from Engine Cranks But Does Not Run proceed to Circuit/System Testing.

1. Ignition ON, command the Engine Controls (EC) Ignition Relay ON and OFF with a scan tool while observing the following EC Ignition Relay control circuit status parameters:
  - Engine Controls Ignition Relay Control Circuit Low Voltage Test Status
  - Engine Controls Ignition Relay Control Circuit Open Test Status
  - Engine Controls Ignition Relay Control Circuit High Voltage Test Status

Each parameter should toggle between OK and Not Run or Not Run and OK.

2. Ignition ON, view the DTC information with a scan tool. DTC P0685 or P0690 should not set.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

## CIRCUIT/SYSTEM TESTING

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

1. Ignition OFF, disconnect the KR71 engine control module relay.
2. Verify that a test lamp illuminates between both of the following relay battery voltage circuit terminals and ground.
  - Terminal 86
  - Terminal 87
  - If the test lamp does not illuminate, test the relay battery voltage circuit for an open/high resistance.

**NOTE:**        **The ignition voltage circuit is between the KR71 engine control module relay and the ECM. The ignition voltage circuit is a feedback circuit.**

3. Ignition ON, verify that a test lamp does not illuminate between the ignition voltage circuit terminal 30 and ground.
  - If the test lamp illuminates, test the ignition voltage circuit for a short to voltage.
4. Connect a 20 A fused jumper wire between the relay switch B+ circuit terminal 87 and the relay switch ignition voltage circuit terminal 30.
5. Ignition ON, observe the scan tool EC Ignition Relay Feedback Signal parameter. The ECM should communicate, and the parameter should display 9-14 V.
  - If not the specified range, or the ECM does not communicate, test the ignition voltage circuit between the engine control module relay and the ECM for a short to ground or for an open/high resistance. If the circuit/connections test normal, replace the K20 ECM.
6. Ignition OFF, connect a DMM set to the diode setting between the control circuit terminal 85 and ground. Verify the DMM displays OL.
  - If not the specified value, test the control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
7. Ignition ON, verify the DMM displays less than 1 V.
  - If not the specified range, test the control circuit for a short to voltage, or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
8. If all circuits test normal, replace the KR71 engine control module relay.

## **COMPONENT TESTING**

**NOTE:**        **Depending on the application, the relay coil resistance will be within one of the following ranges.**

1. Test for one of the following resistance specifications between terminals 85 and 86 of the KR71 engine control module relay:
  - 70-110 ohms
  - 200-250 ohms
  - If not within the specified range, replace the KR71 engine control module relay.
2. Test for infinite resistance between the following terminals of the KR71 engine control module relay:
  - 30 and 86
  - 30 and 87
  - 30 and 85
  - 85 and 87
  - If not the specified value, replace the KR71 engine control module relay.
3. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
  - If greater than the specified range, replace the KR71 engine control module relay.

## REPAIR PROCEDURES

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for K20 ECM replacement, setup, and programming

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