

2018 ENGINE PERFORMANCE

Engine Controls And Fuel - 2.0L (LTG) - Diagnostic Information And Procedures (P0591 - P2635) - Traverse

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0325, P0327, P0328, P0330, P0332, OR P0333

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 P0325

Knock Sensor 1 Circuit

DTC P0327

Knock Sensor 1 Circuit Low Voltage

DTC P0328

Knock Sensor 1 Circuit High Voltage

DTC P0330

Knock Sensor 2 Circuit

DTC P0332

Knock Sensor 2 Circuit Low Voltage

DTC P0333

Knock Sensor 2 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Knock Sensor 1 High Signal	P0327, P06B6	P0325	P0328	P0324*, P0326**
Knock Sensor 2 High Signal	P0332, P06B7	P0330	P0333	P0324*, P0331**
Knock Sensor 1 Low Signal	P0327	P0325	P0328	P0324*, P0326**
Knock Sensor 2 Low Signal	P0332	P0330	P0333	P0324*, P0331**
* Signal Performance High				
** Signal Performance Low				

Circuit/System Description

The knock sensors enable 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 sensors produce an alternating current (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 two knock sensor signals. The ECM receives each knock sensor signal through a dedicated circuit. The ECM learns a minimum knock sensor noise level for all of the engine speed ranges and monitors the normal knock sensor signal. The ECM monitors the internal knock sensor processor test circuits which perform the open circuit diagnostic.

Conditions for Running the DTCs

P0325 and P0330

- Engine is running for 2 s or greater.
- Engine speed is between 400 - 5, 500 RPM for 75 or more cumulative revolutions.
- Engine air flow is between 20 - 2000 mg per cylinder.
- The engine coolant temperature (ECT) is -40Â°C (-40Â°F) or warmer.
- The intake air temperature (IAT) sensor 1 is -40Â°C (-40Â°F) or warmer.

P0327, P0328, P0332, and P0333

Engine speed is less than 8, 500 RPM.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTCs

P0325

The ECM detects knock sensor 1 signal circuit is open.

P0327

The ECM detects knock sensor 1 signal circuit is shorted to ground.

P0328

The ECM detects knock sensor 1 signal circuit is shorted to voltage.

P0330

The ECM detects knock sensor 2 signal circuit is open.

P0332

The ECM detects knock sensor 2 signal circuit is shorted to ground.

P0333

The ECM detects knock sensor 2 signal circuit is shorted to voltage.

Action Taken When the DTCs Set

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

Conditions for Clearing the DTCs

DTCs P0325, P0327, P0328, P0330, P0332, and P0333 are Type B DTCs.

Diagnostic Aids

The following conditions listed below may cause a knock sensor DTC to set:

- Sensor damage.
- Knock sensor and engine mounting surface burrs, casting flash, and foreign material.

- Close proximity of hoses, brackets, and engine wiring.
- Loose brackets.
- Loose or broken accessory drive belts, brackets, components.
- An engine mechanical condition. Refer to [Symptoms - Engine Mechanical](#).

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

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 Running.
2. Verify DTC P0325, P0327, P0328, P0330, P0332, or P0333, is not set.
 - **If the DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC is not set**
3. Verify the appropriate B68 Knock Sensor mounting bolt is properly tightened. Refer to [Fastener Specifications](#).
 - **If not tightened to the correct specification**
Repair a necessary.
 - **Go to next step: If tightened to the correct specification**
4. Verify the scan tool parameters listed below display No while moving the related harnesses and connectors of the B68 Knock Sensor.
 - Cylinder 1 Knock Detected
 - Cylinder 2 Knock Detected
 - Cylinder 3 Knock Detected
 - Cylinder 4 Knock Detected
 - **If No is not displayed**
Repair the wiring harness or connectors.

- **Go to next step: If No is displayed**
- 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.
- 6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
- 7. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B68 Knock Sensor, ignition ON.
2. Test for 1 - 2 V between the low signal circuit terminal 2 or B and ground.
 - **If less than 1 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the low signal circuit terminal 2 or B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance.
 3. Test for less than 2 Ω in the low signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the low signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 1 - 2 V**
3. Test for 2 - 4 V between the high signal circuit terminal 1 or A and ground.
 - **If less than 2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the high signal circuit terminal 1 or A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance.
 3. Test for less than 2 Ω in the high signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the high signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 2 - 4 V**
4. Test or replace the B68 Knock Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Knock Sensor Replacement \(Sensor 1\)](#) [Knock Sensor Replacement \(Sensor 2\)](#)

- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0335 OR P0336

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 P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0335, P0557, P057C, P0651, P118C	P0335	P0236, P0558, P0651, P118C, P24BB	P0336
Signal	P0335, P0506	P0335, P0506	P0335	P0336
Low Reference	-	P0335, P0506	-	P0336

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

P0335 Condition 1

- DTCs P0101, P0102 and P0103 are not set.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

AND

- The airflow into the engine is greater than 1.5 g/s.

Condition 2

- The engine is running.
- The starter is not engaged.

Condition 3

- DTCs P0365 or P0366 are not set.
- The engine is running or the starter is engaged.

P0336 Condition 1

- DTCs P0335 is not set.
- The airflow into the engine is greater than 1.5 g/s.
- Engine speed is greater than 450 RPM.

Condition 2

- The engine is running.
- The starter is not engaged.

Condition 3

- DTCs P0101, P0102, and P0103 are not set.
- The airflow into the engine is greater than 1.5 g/s.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

Condition 4

- DTCs P0365 or P0366 are not set.
- The engine is running or the starter is engaged.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0335 Condition 1

The ECM does not detect a crankshaft position sensor pulse for greater than 4 s.

Condition 2

The ECM does not detect a crankshaft position sensor pulse for greater than 0.3 s.

Condition 3

The ECM does not detect a crankshaft position sensor pulse for 2 out of 10 engine revolutions.

P0336 Condition 1

The ECM detects that 10 or more crankshaft resynchronizations have occurred within 10 s.

Condition 2

The ECM does not detect the synchronization gap on the reluctor wheel for greater than 0.4 s.

Condition 3

The ECM does not detect the synchronization gap on the reluctor wheel for 1.5 s after the starter was engaged.

Condition 4

The ECM detects less than 51 or greater than 65 crankshaft position sensor pulses during 1 engine revolution for 8 out of 10 engine revolutions.

Action Taken When the DTC Sets

- DTCs P0335 and P0336 are Type B DTCs.
- The camshaft position sensor is used to determine engine position.
- The camshaft actuators are commanded to the parked position.

Conditions for Clearing the DTC

DTCs P0335 and P0336 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. Ignition ON.
2. Verify DTC P0651 is not set.
 - **If the DTC is set**

Refer to [DTC P0641, P0651, P0697, P06A3, or P06D2](#).
 - **Go to next step: If the DTC is not set**
3. Engine Running.
4. Verify the scan tool Crankshaft Position Active Counter parameter increments.
 - **If the counter does not increment**

Refer to Circuit/System Testing.
 - **Go to next step: If the counter increments**
5. Verify the scan tool Crankshaft Position Resync Counter parameter displays 0 counts and the engine does not stumble or stall while moving the related harness/connectors of the B26 Crankshaft Position Sensor.
 - **If greater than 0 counts and the engine stumbles or stalls**

Refer to Circuit/System Testing.

- **Go to next step: If 0 counts and the engine does not stumble or stall**

6. 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.
7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B26 Crankshaft Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If 2 Ω or less, replace the K20 Engine Control Module.

- **Go to next step: If less than 5 Ω**

3. Ignition ON.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If between 4.8 - 5.2 V**
6. Ignition OFF, connect a 3 A fused jumper wire to the signal circuit terminal 3, ignition ON.

NOTE: Additional DTCs may set when performing this test.

7. Verify the scan tool Crankshaft Position Sensor Active Counter parameter increments while rapidly tapping the fused jumper wire end to ground.
 - **If the counter does not increment**

Replace the K20 Engine Control Module.
 - **Go to next step: If the counter increments**
8. Verify DTC P0336 is not set.
 - **If the DTC is set**

Inspect for the conditions listed below:
 - Excessive play or looseness of the B26 Crankshaft Position Sensor or the reluctor wheel
 - Improper installation of the B26 Crankshaft Position Sensor
 - Foreign material passing between the B26 Crankshaft Position Sensor and the reluctor wheel
 - Damaged reluctor wheel
 - Excessive air gap between the B26 Crankshaft Position Sensor and the reluctor wheel
 - Engine oil for debris
 - Timing chain, tensioner, and sprockets for wear or damage
 - If any of the conditions above are found, repair as necessary.
 - If all components test normal, test or replace the B26 Crankshaft Position Sensor.
 - **Go to next step: If the DTC is not set**
9. Test or replace the B26 Crankshaft Position Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Crankshaft Position Sensor Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0340, P0341, P0365, OR P0366

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0340

Intake Camshaft Position Sensor Circuit

DTC P0341

DTC P0365

Exhaust Camshaft Position Sensor Circuit

DTC P0366

Exhaust Camshaft Position System Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0641*	P0340, P0365	P0641*	-
Signal	P0340, P0365	P0340, P0365	P0340, P0365	P0341, P0366
Low Reference	-	P0340, P0365	P0340, P0365	-
*Additional DTCs may set.				

Circuit/System DescriptionFor an overview of the component/system, refer to: [Electronic Ignition System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B23 Camshaft Position Sensor	The sensor contains a hall-effect sensor and additional electronics that processes the signal. It detects the change of strength of the magnetic field caused by the reluctor ring. When the strength changes, the sensor changes the amount of current it consumes. This results in a square wave signal of the current, while the voltage stays constant. The control module detects the frequency in which the current changes, which is proportional to the rotational speed.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Reluctor Ring	There are 4 equally spaced teeth on the edge of the camshaft position reluctor ring mounted on the camshaft.

The ECM uses information from the crankshaft position sensor and the camshaft position sensor(s) for sequencing and timing of the spark events.

Conditions for Running the DTC**P0340, P0365 Condition 1**

- DTC P0101, P0102, P0103 = Not set
- MAF Sensor = Greater than 1.5 g/s

Condition 2

- M64 Starter Motor = Active

- Camshaft Position Sensor = Signal received

Condition 3

- Engine = Running
- M64 Starter Motor = Inactive

Condition 4

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized
- M64 Starter Motor = Active

Condition 5

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized

Frequency the DTC runs = Continuously - After the running conditions are met

P0341, P0366 Condition 1

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized
- M64 Starter Motor = Active

Condition 2

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0340, P0365 Condition 1

Camshaft Position Sensor = No Signal - For greater than 5.5 s

Condition 2

Camshaft Position Sensor = No Signal - For greater than 4 s - Starter is engaged.

Condition 3

Camshaft Position Sensor = Less than 4 pulses - For greater than 3 s

Condition 4

Camshaft Position Sensor = No Signal - During the first 2 engine revolutions.

Condition 5

Camshaft Position Sensor = No Signal - During 200 engine revolutions.

P0341, P0366 Condition 1

Camshaft Position Sensor = Less than 4 pulses - During 2 engine revolutions.

Condition 2

Camshaft Position Sensor = Greater than 6 pulses - During 2 engine revolutions.

Condition 3

Camshaft Position Sensor = Less than 398 pulses - Greater than 402 pulses - During 200 engine revolutions.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

- Camshaft Position Actuator = Park position
- Control module command = Reduced Engine Power

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

The cranking period may take longer.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component 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

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0641 is not set.

- **If the DTC is set**

Refer to: [DTC P0641, P0651, P0697, P06A3, or P06D2](#)

- **Go to next step: If the DTC is not set**

3. Engine - Running
4. Verify DTC P0341, P0366 is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. Verify the scan tool parameter:

- Exhaust Camshaft Position Active Counter = Increments
- Intake Camshaft Position Active Counter = Increments
- **If the parameter value does not increment**

Refer to: Circuit/System Testing

- **Go to next step: If the parameter value increments**

6. Verify the scan tool parameter: Exhaust Camshaft Position Active Counter or Intake Camshaft Position Active Counter = Increments

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B23 Camshaft Position Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the parameter value does not increment**

Repair as necessary - Wiring/Terminal(s)/Electrical Connector(s)

- **Go to next step: If the parameter value increments**

7. 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.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

8. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: B23 Camshaft Position Sensor

3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground

- **If 10 ohms or greater**

1. Disconnect the appropriate electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Ground

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
6. Test for 4.8 to 5.2 V between the test points: Signal circuit terminal 3 & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
 7. Verify DTC P0341, P0366 is not set.
 - **If the DTC is set**

Verify the following conditions do not exist:

 - B23 Camshaft Position Sensor & Reluctor Ring - Excessive play/Foreign material passing between the components/Incorrect air gap/Incorrect installation/Loose/Visible Damage
 - Engine Oil - Contaminated/Dirty
 - Timing Chain or Timing Belt - Visible Damage/Worn
 - Timing Chain Tensioner or Timing Belt Tensioner - Visible Damage/Worn
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Test or replace the component: B23 Camshaft Position Sensor
 - **Go to next step: If the DTC is not set**
 8. Test or replace the component: B23 Camshaft Position Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Sensor Replacement - Exhaust](#)
- [Camshaft Position Sensor Replacement - Intake](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P034A OR P034B

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P034A

Crankshaft Position Sensor - Engine Start Position Incorrect

DTC P034B

Crankshaft Position Sensor - Crankshaft Direction Incorrect

Circuit/System Description

The engine control module monitors the speed and the direction of rotation of the crankshaft during an autostop event and memorizes the crankshaft angle at which the engine stopped to be able to start the engine quicker.

Conditions for Running the DTC

P034A

- DTC P0335, P0336, P0651 = Not set
- Engine = Running - After an autostop event.
- Crankshaft position is being verified.

Frequency the DTC runs = Continuously - After the running conditions are met

P034B

- DTC P0335, P0336, P0651 = Not set
- Engine Speed = 400 to 2,000 RPM
- MAF Sensor = Greater than 1.5 g/s
- Crankshaft Position Sensor = Signal received

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 4 s

Conditions for Setting the DTC

P034A Condition 1

The difference between the memorized and actual crankshaft position was greater than 2 reluctor ring teeth during 2 autostart events in one ignition cycle.

Condition 2

The difference between the memorized and actual crankshaft position was greater than 1 reluctor ring teeth during 4 autostart events in one ignition cycle.

P034B

The direction of rotation of the crankshaft has changed more than 3 times within 10 s.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

A DTC may set depending on certain driving conditions and would not require a component replacement. The Circuit/System Verification must be performed.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0335, P0336, P0651 is not set.
 - **If any of the DTCs are set**
Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If none of the DTCs are 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.

Verify the DTC does not set.

- **If the DTC sets**

Test or replace the component: B26 Crankshaft Position Sensor

- **Go to next step: If the DTC is not set**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Crankshaft Position Sensor Replacement

DTC P0351, P0352, P0353, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, OR P2310

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

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 P2300

Ignition Coil 1 Control Circuit Low Voltage

DTC P2301

Ignition Coil 1 Control Circuit High Voltage

DTC P2303

Ignition Coil 2 Control Circuit Low Voltage

DTC P2304

Ignition Coil 2 Control Circuit High Voltage

DTC P2306

Ignition Coil 3 Control Circuit Low Voltage

DTC P2307

Ignition Coil 3 Control Circuit High Voltage

DTC P2309

Ignition Coil 4 Control Circuit Low Voltage

DTC P2310

Ignition Coil 4 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 3/C @ T8A Ignition Coil 1	P0300, P2300	P0300, P0351	P0300, P2301	P0300
Control - Terminal 3/C @ T8B Ignition Coil 2	P0300, P2303	P0300, P0352	P0300, P2304	P0300
Control - Terminal 3/C @ T8C Ignition Coil 3	P0300, P2306	P0300, P0353	P0300, P2307	P0300
Control - Terminal 3/C @ T8D Ignition Coil 4	P0300, P2309	P0300, P0354	P0300, P2310	P0300
Ground - Terminal 1/A @ T8A Ignition Coil 1	-	P0300, P0351*	-	P0300

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground - Terminal 1/A @ T8B Ignition Coil 2	-	P0300, P0352*	-	P0300
Ground - Terminal 1/A @ T8C Ignition Coil 3	-	P0300, P0353*	-	P0300
Ground - Terminal 1/A @ T8D Ignition Coil 4	-	P0300, P0354*	-	P0300
*Additional DTCs may set.				

Circuit/System Description

For an overview of the component/system, refer to: [Electronic Ignition System Description](#)

Circuit	Description
Control	The output circuit is switched to ground to activate the component.
Ground	Chassis Ground

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
T8 Ignition Coil	The ignition system on this engine uses ignition coils with integrated power transistors.

The ECM controls the spark event for each cylinder through individual ignition coil control circuits. When the ECM commands the ignition control circuit On, electrical current flows through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM commands the ignition control circuit Off, interrupting current flow through the primary winding. The collapsing magnetic field created by the primary winding induces a high voltage in the secondary winding, which is connected to the spark plugs.

Conditions for Running the DTC

- Engine = Running
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

Component View Reference

Powertrain Component 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

Special Tools

J-26792 Ignition Spark Tester

Equivalent regional tools: **Special Tools**

Circuit/System Verification

1. Engine - Running
2. Verify the scan tool parameter:
 - Ignition Coil 1 - 4 Control Circuit High Voltage Test Status = OK or Not Run
 - Ignition Coil 1 - 4 Control Circuit Low Voltage Test Status = OK or Not Run
 - Ignition Coil 1 - 4 Control Circuit Open Test Status = OK or Not Run
 - **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Verify the scan tool parameter:
 - Ignition Coil 1 - 4 Control Circuit High Voltage Test Status = OK or Not Run
 - Ignition Coil 1 - 4 Control Circuit Low Voltage Test Status = OK or Not Run
 - Ignition Coil 1 - 4 Control Circuit Open Test Status = OK or Not Run
 - Perform the action while monitoring the parameter:
 - Wiggle the harness and connector: T8 Ignition Coil
 - Wiggle the harness and connector: K20 Engine Control Module
 - **If not the specified state**

Repair as necessary - Wiring/Terminal(s)/Electrical Connector(s)

- **Go to next step: If the specified state**

4. 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.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: T8 Ignition Coil
3. Test for less than 10 ohms between the test points: Ground circuit terminal 1/A & Ground
 - **If 10 ohms or greater**
 1. Disconnect the ground connection: Ground terminal
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 1/A @ Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **Go to next step: If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 3/C & B+
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 3/C @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp does not turn On**
6. Remove - Test Lamp
7. Engine - Running
8. Verify the scan tool parameter: Ignition Coil 1 - 4 Control Circuit High Voltage Test Status = OK or Not Run
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for less than 1 V between the test points: Control circuit terminal 3/C @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If the specified state**
9. Ignition/Vehicle - Off
10. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 3/C & Ignition circuit terminal 4/D
11. Engine - Running
12. Verify the scan tool parameter: Ignition Coil 1 - 4 Control Circuit High Voltage Test Status = OK or Not Run
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for less than 2 ohms between the test points: Control circuit terminal 3/C @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

13. Test or replace the component: T8 Ignition Coil

Component Testing

NOTE: **Circuit/System Testing must be performed before proceeding with Component Testing.**

1. Ignition/Vehicle - Off
2. Remove the appropriate component: T8 Ignition Coil - Leave the electrical connector connected.
3. Install the special tool: J-26792 Ignition Spark Tester
4. Engine - Running

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

5. Verify there is spark at the tool.

- **If there is no spark**

Replace the component: T8 Ignition Coil

- **Go to next step: If there is spark**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Ignition Coil Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0420

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

Circuit/System Description

A 3-way catalyst controls emissions of hydrocarbons, carbon monoxide (CO) and nitrogen oxide (NO_x). The catalyst within the converter promotes a chemical reaction, which oxidizes the hydrocarbons and the CO that are present in the exhaust gas. This process converts the hydrocarbons and the CO into water vapor and carbon dioxide (CO₂), and reduces the NO_x, converting the NO_x into nitrogen. The catalyst also stores oxygen. The engine control module (ECM) monitors this process by using heated oxygen sensors (HO₂S) that are in the exhaust stream before and after the 3-way catalyst. The HO₂S 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 monitoring the HO₂S during an off-idle, decel fuel cut off (DFCO) event. When the catalyst is functioning properly, the post catalyst HO₂S response to the fuel conditions during the DFCO event is slow compared to the response of the pre catalyst HO₂S. When the post HO₂S response is near that of the pre HO₂S, the oxygen storage capability and efficiency of the catalyst may be degraded below an acceptable threshold.

Conditions for Running the DTC

- DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0131, P0132, P0133, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0141, P015A, P015B, P0171, P0172, P0201, P0202, P0203, P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P1248, P1249, P124A, P124B, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2270, or P2271 is not set.
- The engine speed is between 950 - 2,950 RPM to enable the catalyst diagnostic. Once the engine speed is in range, the engine speed must be between 900 - 3,050 RPM to keep the test enabled.
- Accelerator pedal position is at most 4%.
- Ethanol estimation is not active.
- Evaporative emission (EVAP) purge is not active.
- Post HO2S heater is ON for greater than 180 s.
- Mass air flow (MAF) is between 2 - 13 g/s.
- System voltage is between 10 - 32 V.
- Vehicle speed is between 64 - 126 km/h (40 - 78 MPH) to enable the catalyst diagnostic. To keep the test enabled the vehicle speed is between 56 - 132 km/h (35 - 82 MPH).
- Catalyst calculated temperature is between 500 - 900°C (932 - 1,652°F).
- Engine is operating in closed loop.
- Engine is operating in DFCO.

This diagnostic attempts one test during each valid OFF-idle period once the above conditions have been met. This diagnostic attempts up to 4 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 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0420 is a Type A DTC.

Diagnostic Aids

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

- Engine misfire
- High engine oil or high coolant consumption
- Retarded spark timing
- Weak or poor spark
- Lean fuel mixture
- Rich fuel mixture
- 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 Verification

1. Ignition On.
2. Verify there are no other DTCs set.
 - **If other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **Go to next step: If no other DTCs are set**
3. Operate the vehicle within the Conditions for Running the DTC.
4. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
 - **If Yes is not displayed**

Refer to step 3.
 - **Go to next step: If Yes is displayed**
5. Verify the Catalyst Monitor Test Result parameter displays Passed when performing the steps listed below:
 1. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE: When the test has completed, the Catalyst Monitor Test Counter will increment by one and the Catalyst Monitor Test Result will indicate Passed, Failed or No Result.
 2. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
 3. Verify the scan tool Catalyst Monitor Test Result displays Passed.
 - **If No Result is displayed**

Repeat steps 3 - 5 until the Test Result parameter indicates Passed or Failed
 - **If Failed is displayed**

Refer to Circuit/System Testing
 - **Go to next step: If Passed is displayed**
6. All OK.

Circuit/System Testing

1. Verify the conditions listed below do not exist with the catalytic converter:
 - Dents
 - Severe discoloration caused by excessive temperatures
 - Road damage
 - Internal rattles caused by damaged catalyst substrate
 - Restrictions
 - **If a condition is found**

Replace the catalytic converter.
 - **Go to next step: If no condition is found**
2. Verify the conditions listed below do not exist with the exhaust system:
 - Leaks
 - Restrictions
 - Physical damage
 - Loose or missing hardware

- **If a condition is found**

Repair or replace the component as necessary.

- **Go to next step: If no condition is found**

3. Verify the conditions listed below do not exist with the B52B Heated Oxygen Sensor 2:

- Incorrect torque
- Damage

- **If a condition is found**

Replace the B52B Heated Oxygen Sensor 2 or repair the condition as necessary.

- **Go to next step: If no condition is found**

4. Replace the catalytic converter.

Repair Instructions

- **Warm Up Three-Way Catalytic Converter Replacement (LTG).**
- **Exhaust Leakage**
- **Heated Oxygen Sensor Replacement - Sensor 2**
- Perform the HO2S Heater Learn procedure with a scan tool after replacing a heated oxygen sensor.
- **Restricted Exhaust**

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn Off the ignition for 60 s
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.

- **If Yes is not displayed**

Refer to step 5.

- **Go to next step: If Yes is displayed**

7. Verify the Catalyst Monitor Test Result displays Passed when performing the steps listed below:
 1. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE:

When the test has completed, the Catalyst Monitor Test Counter will increment by one and the Catalyst Monitor Test Result will indicate Passed, Failed or No Result.

2. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
3. Verify the scan tool Catalyst Monitor Test Result displays Passed.

- **If No Result is displayed**

Repeat steps 5 - 7 until the Test Result indicates Passed or Failed

- **If Failed is displayed**

Refer to Circuit/System Testing

- **Go to next step: If Passed is displayed**

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 (EVAP) system. This diagnostic tests the 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 engine control module (ECM) using the fuel tank pressure (FTP) 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 P010B, P012B, P012C, P012D, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P0222, P0223, P0236, P0237, P0238, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0461, P0462, P0463, P0496, P0498, P0499, P0502, P0503, P0722, P0723, P111E, P117D, P017C, P017D, P017B, P117B, P117F, P117E, P117C, P2066, P2067, P2068, P1221, P222B, P222C, P222D, P222E, P262B. are not set.
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine coolant sensor (ECT) is greater than 63°C (145°F)
- The fuel level is between 10 - 90%.
- The start-up engine coolant temperature (ECT) and the start-up intake air temperature (IAT) are within 8°C (14°F).
- The engine run time before shut-off was greater than 10 min.
- The drive distance before engine shut-off was greater than 5 km (3 mi).
- The ambient air temperature at the end of the drive cycle is between 0 - 34°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 40 min to complete. The control module will not make more than 2 test attempts per day. The time since the last completed engine off natural vacuum test must be at least 17 h if passed or 10 h if failed.

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 engine off natural vacuum 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 EVAP 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 **GE 41413-A** , move all EVAP components while observing smoke with the **GE 41413-SPT** .
- Individual components can be isolated and tested using adapters in the **GE 41413-300** .
- When servicing the EVAP system, test pressure must not exceed 13 in H2O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.
- A condition may exist where a leak in the EVAP 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 EVAP system and then observe the FTP Sensor parameter for vacuum decay.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component 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** EVAP Service Port Access Tool
- **GE 41413-A** Evaporative Emissions System Tester (EEST)
- **GE 41413-300** EVAP Cap and Plug Kit
- **GE 41413-SPT** High Intensity White Light

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

Circuit/System Testing

NOTE:

- Refer to the **GE 41413-A** 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 or produce smoke from a leak.
- Ensure that the underbody temperature of the vehicle and the tester are similar.

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the Q12 Evaporative Emission Canister Purge Solenoid Valve and install the **CH 48096** .
2. Connect the **GE 41413-A** to the **CH 48096** .
3. Command the EVAP Purge/Seal function to Not Venting or System Seal with a scan tool to seal the EVAP system.
4. Use the flow meter on the **GE 41413-A** calibrated to 0.51 mm (0.020 in) to determine if there is a leak.
 - **If a leak is detected**
 1. Use the **GE 41413-A** to apply smoke to the EVAP system at the purge tube service port until the leak is located using the **GE 41413-SPT** .
 - If leak is detected, repair or replace the affected component as necessary.
 - **Go to next step: If no leak is detected**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P0443, P0458, OR P0459

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 Valve Control Circuit

DTC P0458

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit Low Voltage

DTC P0459

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Ignition	P0443	P0443, P0458	P0690
Control	P0443, P0458	P0443, P0458	P0459

Circuit/System Description

The evaporative emission (EVAP) purge solenoid valve is used to purge fuel vapor from the EVAP canister to the intake manifold. The EVAP purge solenoid valve is pulse width modulated (PWM). Ignition voltage is supplied directly to the EVAP purge solenoid valve. The engine control module (ECM) controls the solenoid valve by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can

determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. A scan tool will display the amount of ON time as a percentage.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V.
- The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0443

The ECM detects the EVAP Purge Solenoid Valve control circuit is open for greater than 0.25 s.

P0458

The ECM detects the EVAP Purge Solenoid Valve control circuit is shorted to ground for greater than 0.25 s.

P0459

The ECM detects the EVAP Purge Solenoid Valve control circuit is shorted to voltage for greater than 0.25 s.

Action Taken When the DTC Sets

DTC P0443, P0458 and P0459 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0443, P0458 and P0459 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component 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

NOTE: The audible clicking intensity will vary depending on mounting locations and interference with the fuel injectors clicking. You may also feel a change in the frequency of clicking.

1. Ignition ON, verify DTC P0690 is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **Go to next step: If the DTC is not set**

2. Command the EVAP Purge Solenoid Valve from 0 to 50% and back to 0% with a scan tool while observing the following control circuit status parameters:

- EVAP Purge Solenoid Valve Control Circuit Open Test Status
- EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status
- EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status
- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **Go to next step: If Malfunction is not displayed**

3. Verify the EVAP Purge Solenoid Valve control circuit parameters above do not display Malfunction when moving the related harnesses and connectors of the Q12 Evaporative Emission Purge Solenoid Valve.

- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **Go to next step: If Malfunction is not displayed**

4. 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.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **Go to next step: If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve. Ignition ON,

2. Verify that a test lamp illuminates between the ignition voltage circuit terminal A or 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp and disconnect any component connected to the ignition circuit.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test all components connected to the ignition voltage circuit for a short and replace as necessary.

- **Go to next step: If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the ignition circuit terminal A or 1 and the control circuit terminal B or 2.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
 4. Remove the test lamp.
 5. Verify the scan tool EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter is OK when commanding the EVAP Purge Solenoid Valve to 50% with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If OK is displayed**
 6. Install a 3 A fused jumper wire between the control circuit terminal B or 2 and the ignition circuit terminal A or 1.
 7. Verify the scan tool EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Purge Solenoid Valve to 50% with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **Go to next step: If Malfunction is displayed**
 8. Test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Test for 10-30 Ω between the control terminal B or 2 and the ignition circuit terminal A or 1.
 - **If not between 10-30 Ω**

Replace the Q12 Evaporative Emission Purge Solenoid Valve.
 - **Go to next step: If between 10-30 Ω**
3. All OK.

Dynamic Test

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Install a 3 A fused jumper wire between the ignition, terminal A or 1 and 12 V. Install a jumper wire between the control terminal B or 2 and ground.
3. Verify the Evaporative Emission Purge Solenoid Valve turns on & off/clicks and flows vacuum.

- If it does not turn on & off/click or flow vacuum.

Replace the Q12 Evaporative Emission Purge Solenoid Valve.

- Go to next step: If it does turn on & off/clicks and flows vacuum.

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup

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 Emission (EVAP) Vent System Performance

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

Circuit/System Description

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path. There are two parts to this test.

- Part one uses the fuel tank pressure sensor to indicate vacuum comes within a calibrated range within a calibrated time.
- The second part of this test looks for excessive vacuum which would indicate a restriction. The duration of this second part of is a function of purge volume through the system.

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP purge and vent solenoid valves.

ECM Command	EVAP Purge Solenoid Valve	EVAP Vent Solenoid Valve
ON	Open	Closed, Not Venting
OFF	Closed	Open, Venting

Conditions for Running the DTC

- DTCs P0068, P00C8, P00C9, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0601, P0604, P0606, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2176, are not set.
- The ignition voltage is between 11-32 V.
- The barometric pressure (BARO) is more than 70 kPa.
- The fuel level is between 10-90%.
- The startup engine coolant temperature (ECT) is less than 35°C (95°F).

- The startup intake air temperature (IAT) is between 4-30Å°C (39-86Å°F).
- DTC P0446 runs once per cold start, for up to 17 min, when the above conditions are met.

Conditions for Setting the DTC

NOTE: **There are two stages to setting this DTC. Stage one, prep test, then stage two test.**

- If fuel tank pressure sensor reading is greater than 2.5 in H₂O (0.62 kPa) of pressure or less than -5 in H₂O (-1.24 kPa) of vacuum for 60 s.

OR

- If fuel tank pressure sensor reading is less than -12 in H₂O (-2.98 kPa) of vacuum for 5 s before 10 L (2.6 gal) of purge volume has passed through the system.
- After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.

Action Taken When the DTC Sets

DTC P0446 is a Type B DTC.

Conditions for Clearing the MIL/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 solenoid valve inlet
- Pinched vent hose

A blockage in the vent system may also cause a poor fuel fill problem

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

Special Tools

- **CH-44284-2** Fuel Flapper Door Holder
- **GE-41415-60** Capless Fuel Fill Adapter
- **GE-41413-A** Evaporative Emissions System Tester (EEST)

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

NOTE: This vehicle has a capless fuel fill design that requires the use of CH-44284-2 Fuel Flapper Door Holder to hold the two flapper valves open.

- **Install this tool so that the raised rib nests just inside the flapper door outer lip. The flappers will hold it in place.**
- **Be careful the force of the flapper doesn't push the tool back out.**
- **Do not insert tool any further into the fuel neck or it may get stuck or fall into the lower fill tube.**

1. Ignition ON.

2. Verify DTC P0449 is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **Go to next step: If the DTC is not set**

3. Ignition OFF, install the CH-44284-2 in the fuel fill neck. Ignition ON.

4. Verify the scan tool Fuel Tank Pressure Sensor voltage parameter is within 1.3-1.7 V.

- **If not between the 1.3-1.7 V**

Refer to P0452, P0453 within [DTC P0451-P0454](#).

- **Go to next step: If between the 1.3-1.7 V**

5. Remove the CH-44284-2. Engine idling at operating temperature for 5 min,

6. Verify the scan tool Fuel Tank Pressure Sensor parameter does not increase to greater than 2.5 V when commanding the EVAP Purge Solenoid Valve to 50%.

- **If greater than 2.5 V**

Refer to Circuit System Testing.

- **Go to next step: If 2.5 V or less**

7. 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.

- **If the DTC sets**

Refer to Circuit System Testing.

- **Go to next step: If the DTC does not set**

8. All OK.

Circuit/System Testing

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

NOTE: Refer to the GE-41413-A operation manual for detailed instructions in

Evaporative Emission System Diagnosis.

NOTE:

The GE-41415-60 is a dual purpose tool used for EVAP testing and diesel induction leak testing. It has two positions for the rubber stopper, identified on the tube by a letter A and B. Slide the stopper to just above either line depending on the test performed.

- Letter A position line is for diesel induction leak testing
- Letter B position line is for EVAP testing

1. Test for a blockage or restrictions in the EVAP system components listed below and repair as necessary.

- Evaporative Emission Vent System Hoses
- Evaporative Emission Canister
- Q13 Evaporative Emission Vent Solenoid Valve
- Evaporative Emission Vent Filter

2. Reconnect all previously disconnected EVAP hardware.

NOTE:

Install the GE-41415-60, with the tube pointing toward the ground, into the capless fuel fill opening. Wedge the stopper into the opening with just enough force to retain this tools threaded end pointing out, parallel within the opening.

3. Install the GE-41415-60 into the fuel tank filler neck. Connect the GE-41413-A to the GE-41415-60.

4. Command the EVAP Purge/Seal function to Not Venting or System Seal with a scan tool to seal the EVAP system.

5. Turn the nitrogen/smoke valve on the GE-41413-A to nitrogen.

NOTE:

DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.

6. Use the remote switch to activate the GE-41413-A and pressurize the fuel tank to 5.0 in H20 (1.24 kPa).

7. Verify the scan tool Fuel Tank Pressure Sensor parameter is 0 in H20 (0 kPa) when commanding the EVAP Vent Solenoid Valve to OFF.

- **If not 0 in H20**

Test for a blockage or a restriction in the EVAP vent hose or inlet. If the inlet or hose test normal, replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **Go to next step: If 0 in H20**

8. 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.

- **If the DTC sets**

Refer to Step 1 above.

- **Go to next step: If the DTC does not set**

9. All OK.

Repair Instructions

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

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

- [Fuel Tank Pressure Sensor Replacement](#)

DTC P0449, P0498, OR P0499

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 P0449

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit

DTC P0498

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit Low Voltage

DTC P0499

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P0449, P0498	P0449	-
Control	P0449, P0498	P0449	P0499

Circuit/System Description

The evaporative emission (EVAP) vent solenoid valve is a normally open valve. Battery voltage is supplied to the EVAP vent solenoid valve through a fuse. The engine control module (ECM) grounds the EVAP vent solenoid valve control circuit through an internal switch called a driver. The evaporative emission (EVAP) vent solenoid valve is a normally open valve. Battery voltage is supplied to the EVAP vent solenoid valve through a fuse. A scan tool will display the commanded state of the EVAP vent solenoid valve as ON (Not Venting) or OFF (Venting).

Conditions for Running the DTC

The DTCs run continuously.

Conditions for Setting the DTC

P0449

The ECM detects the EVAP Vent Solenoid Valve control circuit is open within 0.25 s.

P0498

The ECM detects the EVAP Vent Solenoid Valve control circuit is shorted to ground within 0.25 s.

P0499

The ECM detects the EVAP Vent Solenoid Valve control circuit is shorted to voltage within 0.25 s.

Action Taken When the DTC Sets

DTC P0449, P0498 and P0499 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0449, P0498 and P0499 are Type B DTCs.

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

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

[Circuit/System Verification](#)

NOTE: An audible click may be heard when performing step 2 below.

1. Ignition ON.
2. Command the EVAP Vent Solenoid Valve to ON (Not Venting) and OFF (Venting) with a scan tool while observing the following control circuit status parameters:
 - EVAP Vent Solenoid Valve Control Circuit Open Test Status
 - EVAP Vent Solenoid Valve Control Circuit Low Voltage Test Status
 - EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing
 - **Go to next step: If Malfunction is not displayed**
3. Verify the EVAP Vent Solenoid Valve control circuit parameters above do not display Malfunction when moving the related harnesses and connectors of the Q13 Evaporative Emission Vent Solenoid Valve.
 - **If Malfunction is displayed**

Refer to Circuit/System Testing
 - **Go to next step: If Malfunction is not displayed**
4. 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.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing
 - **Go to next step: If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve, Ignition ON,
2. Verify that a test lamp illuminates between the B+ circuit terminal A or 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the B+ circuit for a short and replace as necessary.
 - **Go to next step: If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the B+ circuit terminal A or 2 and the control circuit terminal B or 1.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is OK when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal B or 1 and the B+ circuit terminal A or 2.
7. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **Go to next step: If Malfunction is displayed**
8. Test or replace the Q13 Evaporative Emission Vent Solenoid Valve.

Component Testing

1. Ignition OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
2. Test for 10-30 Ω between the control terminal B or 1 and the B+ circuit terminal A or 2.
 - **If not between 10-30 Ω**

Replace the Q13 Evaporative Emission Vent Solenoid Valve.
 - **Go to next step: If between 10-30 Ω**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0451, P0452, P0453, OR P0454

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 Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0340, P0365, P0452, P0522, P0532, P055C, P0641, P2227, P2228	P0451	P0446, P0452	P018D, P0193, P0453, P0523, P0533, P055D, P0641, P2227	-
Signal	P0452	P0451	P0452, P0453	P0453	P0451, P0454

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Low Reference	-	P0446, P0451	P0446, P0453, P0463	-	P0451

Typical Scan Tool Data

Fuel Tank Pressure Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON, Engine OFF			
Parameter Normal Range: 1.3 - 1.7 V			
5 V Reference	0 V	0 V	4.2 - 5 V
Signal	0 V	0 V	5 V
Low Reference	-	4.5 V	-

Circuit/System Description

The fuel tank pressure sensor measures vapor pressure or vacuum in the evaporative emission (EVAP) system. The engine control module (ECM) supplies a 5 V 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 min.

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 min.
- A refueling event is not detected. A refueling event is confirmed if the fuel level has a persistent change of 10% for 30 s during a 10 min refueling rationality test.

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 0.15 V for greater than 10 s.

P0453

The fuel tank pressure sensor voltage is greater than 4.9 V for greater than 10 s.

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 greater than 0.45 in H₂O (0.11 kPa) in the span of 1 s but less than 1 in H₂O (0.25 kPa) in 12.5 ms. This test must fail twice to set this DTC.

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 DTC 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 DTC to set. Scan tool control functions, 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%, 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 **GE-41413-A** while taking a snapshot.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component 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

GE-41413-A Evaporative Emission System Tester

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Remove the fuel cap.
2. Ignition ON, engine OFF.
3. Verify the scan tool Fuel Tank Pressure sensor parameter is between 1.3 and 1.7 V.
 - **If not between 1.3 - 1.7 V**

Refer to Circuit/System Testing.
 - **Go to next step: If between 1.3 - 1.7 V**
4. 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.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, this may take up to 2 min, for all vehicle systems to power down. Disconnect the harness connector at the B150 Fuel Tank Pressure Sensor.
2. Test for less than 5 Ω of resistance between the low reference circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 4.8 - 5.2 V**
5. Verify the scan tool Fuel Tank Pressure parameter is less than 0.2 V.

- **If 0.2 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON
 2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If less than 0.2 V**
- 6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
- 7. Verify the scan tool Fuel Tank Pressure sensor parameter is greater than 4.7 V.
 - **If 4.7 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If greater than 4.7 V**
- 8. Test or replace the B150 Fuel Tank Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Tank Pressure Sensor Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P0455

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 (EVAP) System Large Leak Detected

Circuit/System Description

The engine control module (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 EVAP vent solenoid valve and purge solenoid valve ON, allowing vacuum into the EVAP 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

- DTCs P00C8, P00C9, P010C, P010D, P16A0, P16A1, P16A2, P160E, P160D, P16F3, P0068, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0449, P0452, P0453, P0454, P0502, P0503, P0601, P0604, P0606, P0722, P0723, P1104, P1682, P2100, P2101, P2102, P2103, P2135, P2176, P2227, P2228, P2229, P2230 are not set.
- The ignition voltage is between 11 - 32 V.

- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10 - 90%.
- The cold startup engine coolant temperature (ECT) and the startup intake air temperature (IAT) are within 8Â°C (14Â°F).
- The startup engine coolant temperature (ECT) is less than 35Â°C (95Â°F).
- The startup intake air temperature (IAT) is between 4 - 34Â°C (39 - 93Â°F).
- DTC P0455 runs once per cold start, shortly after purge is enabled followed by vent system performance test P0446.

Conditions for Setting the DTC

- The EVAP system is not able to achieve or maintain a calibrated level of vacuum before a calibrated amount of purge volume has passed through the system.
- After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.
- With a DTC P0455 detected a weak vacuum follow-up test (fuel cap replacement test) will run and pass if tank vacuum is greater than 2.74 kPa (11 in H2O). This test will run for a maximum of 21 min. This test runs until it passes.

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 EVAP purge solenoid valve, purge pipe, EVAP canister, or vapor pipe, can cause this DTC to set.
- The EVAP system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. For example, when injecting smoke at the service port remove the fuel fill cap, or temporarily leave the vent open, until smoke is observed, then close the system and continue testing. If using a fuel cap adapter at the filler neck, use the **J-41413-VLV** at the service port to allow the system to fill faster.
- To help locate intermittent leaks using the **GE-41413-A** move all EVAP components while observing smoke with the **GE-41413-SPT**.
- Individual components can be isolated and tested using adapters in the **J-41413-300**.
- When servicing the EVAP system, test pressure must not exceed 13 in H2O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.
- A condition may exist where a leak in the EVAP 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 EVAP system and then observe the Fuel Tank Pressure Sensor parameter for vacuum decay.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

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** EVAP Service Access Port Tool
- **GE-41413-A** Evaporative Emissions System Tester
- **GE-41413-SPT** High Intensity White Light
- **GE-41415-30** Fuel Tank Cap Adapter
- **GE-41415-60** Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter
- **J-41413-300** EVAP Cap and Plug Kit
- **J-41413-311** EVAP Plug (Brass Nozzle)
- **J-41413-VLV** EVAP Service Port Vent Fitting

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 or produce smoke from a leak.**
- **Refer to the GE-41413-A operation manual for detailed instructions in [Evaporative Emission System Diagnosis](#).**

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the purge solenoid valve and install the **CH-48096** .
2. Connect the **GE-41413-A** to the vehicle EVAP service port adapter.
3. Ignition ON, command the EVAP Purge/Seal function to Not Venting or System Seal with a scan tool to seal the EVAP system.
4. Verify that there is no leak in the EVAP system using the flow meter on the **GE-41413-A** , calibrated to 0.51 mm (0.020 in).
 - **If a leak is detected**
 1. Apply smoke to the EVAP system at the service access port adapter with the **GE-41413-A** .
 2. Locate the leak using the **GE-41413-SPT** .
 - When the leak is located, repair or replace the affected component as necessary.
 - **Go to next step: If no leak detected**

NOTE:

The steps below test for a restriction in the purge path.

5. Connect the **GE-41413-A** nitrogen/smoke hose to the **J-41413-311** or **GE-41415-60** for capless vehicles.
6. Disconnect the hose at the fuel cap end of the **GE-41415-30** and connect to the **J-41413-311**.
7. Install the **GE-41415-30** or **GE-41415-60**, filler neck end only, to the vehicle.
8. Engine idling, command the Purge/Seal function to Not Venting or System Seal with a scan tool to seal the system.

NOTE: The scan tool will abort purge when a predetermined value is reached. This is to prevent damage to the fuel tank.

9. Command the EVAP Purge Solenoid Valve to 10-30% with a scan tool.
10. Verify the vacuum/pressure gauge on the **GE-41413-A** and the scan tool Fuel Tank Pressure Sensor parameter both show vacuum.
 - **If the vacuum/pressure gauge shows vacuum but the Fuel Tank Pressure Sensor parameter does not show vacuum**

Replace the B150 Fuel Tank Pressure Sensor.
 - **If both do not show vacuum**

Repair the restriction in the purge path.
 - **Go to next step: If both show vacuum**
11. Verify that the Fuel Tank Pressure Sensor parameter increases to greater than 3.2 V, and the pressure values are similar between the scan tool Fuel Tank Pressure Sensor and the vacuum/pressure gauge on the **GE-41413-A**.
 - **If not within the specified range**

Replace the B150 Fuel Tank Pressure Sensor.
 - **Go to next step: If within the specified range**
12. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Tank Pressure Sensor Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

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 Emission (EVAP) System Flow During Non-Purge

Circuit/System Description

This DTC tests for undesired intake manifold vacuum flow to the evaporative emission (EVAP) system. The engine control module (ECM) seals the EVAP system by commanding the EVAP purge solenoid valve OFF and the vent solenoid valve ON. The ECM 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 more than a predetermined value within a predetermined time, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the Open or Closed states of the EVAP purge and vent solenoid valves.

ECM Command	EVAP Purge Solenoid Valve	EVAP Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P00C8, P00C9, P010C, P010D, P16A0, P16A1, P16A2, P160E, P160D, P16F3, P0068, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0449, P0452, P0453, P0454, P0502, P0503, P0601, P0604, P0606, P0722, P0723, P1104, P1682, P2100, P2101, P2102, P2103, P2135, P2176, P2227, P2228, P2229, P2230 are not set.
- The ignition voltage is between 11 - 32 V.
- The engine OFF time is greater than 8 h,
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10 - 90%.
- The startup engine coolant temperature (ECT) is less than 35Â°C (95Â°F).
- The startup intake air temperature (IAT) is between 4 - 30Â°C (39 - 86Â°F).
- DTC P0496 runs once per cold start, for up to 17 min, when the above conditions are met.

Conditions for Setting the DTC

The ECM detects more than 10 in H2O vacuum for 5 s during a non-purge condition.

Action Taken When the DTC Sets

DTC P0496 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0496 is a Type B DTC.

Diagnostic Aids

An intermittent condition could be caused by an improperly installed or damaged EVAP purge solenoid valve or by a temporary blockage or restriction in the EVAP purge solenoid valve.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

Circuit/System Verification

1. 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.
2. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing
 - **Go to next step: If the DTC does not set**
3. All OK

Circuit/System Testing

1. Ignition ON, engine OFF.
2. Seal the EVAP system using the Purge/Seal function with a scan tool.
3. Start the engine.
4. Observe the FTP sensor with a scan tool. The FTP sensor parameter should be less than 1.7 V after 90 s.
 - **If not within specifications**

Replace the Q12 Evaporative Emission Purge Solenoid Valve
 - **Go to next step: If within Specifications**
5. All OK

Repair Instructions

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

Evaporative Emission Canister Purge Solenoid Valve Replacement

DTC P0506 OR P0507

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 s.
- The ignition voltage is between 11 - 32 V.
- 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 engine speed is steady within 25 RPM.
- The engine is idling for greater than 5 s.
- 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 s.

P0507

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

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 Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Throttle Actuator Control (TAC) System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify there are no other DTCs set.
 - **If any other DTCs are set**
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.
 - **Go to next step: If no other DTCs are set**
3. Verify the scan tool Throttle Body Idle Airflow Compensation parameter is less than 90%.
 - **If 90% or greater**
Refer to **Throttle Body Cleaning** .
 - **Go to next step: If less than 90%**
4. Engine Idling at the normal operating temperature.
5. Verify the actual Engine Speed is not 100 RPM less than the Desired Idle Speed.
 - **If 100 RPM less than the Desired Idle Speed**
Refer to Circuit/System Testing.
 - **Go to next step: If 100 RPM greater than the Desired Idle Speed**
6. Verify the actual Engine Speed is not 200 RPM greater than the Desired Idle Speed.
 - **If 200 RPM greater than the Desired Idle Speed**
Refer to Circuit/System Testing.
 - **Go to next step: If 200 RPM less than the Desired Idle Speed**
7. 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.
8. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
9. All OK

Circuit/System Testing

P0506

1. Verify the conditions listed below do not exist.
 - 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.
 - **Go to next step: If a condition is not found**
2. All OK.

1. Verify the conditions listed below do not exist.

- Vacuum leaks
- A throttle valve that does not close correctly
- Verify the correct operation of the crankcase ventilation system. Inspect for the conditions listed below:
 - Improper 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.
- **Go to next step: If a condition is not found**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Throttle Body Assembly Replacement](#)

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, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0101-P0103, P0106-P0108, P0112, P0113, P0117-P0118, P0122, P0123, P0128, P0171, P0172, P0192, P0193, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301-P0304, P0335, P0336, P0351-P0354, P0506, P0507, P0628, P0697, P06A3, P0722, P0723, P1248, P1249, P124A, P124B, P182E, P1915, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157 are not set.
- The catalyst temperature is less than 500Â°C (932Â°F).
- The engine coolant temperature is warmer than -12Â°C (10.4Â°F).
- The barometric pressure is greater than 75 kPa.
- The engine speed is between 250 - 3000 RPM.
- The accelerator pedal position is less than 1 percent.
- The engine is running for less than 20 s 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 Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

NOTE: **Circuit/System Verification 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 verify that the scan tool Cylinder 1-4 Current Misfire Counters are not incrementing during first 500 engine cycles.

- **If Cylinder 1-4 Current Misfire Counters are incrementing**

Refer to Circuit/System Testing.

- **Go to next step: If Cylinder 1-4 Current Misfire Counters are not incrementing**
2. 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.
 3. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
 4. All OK.

Circuit/System Testing

1. Verify that the fuel pressure is not too low or too high - Refer to [Fuel System Diagnosis](#).
 - If a condition is found, repair or replace components as necessary.
 - Go to next step: If the fuel pressure is OK
2. Verify that the fuel is not contaminated - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
 - If the fuel is contaminated, clean the fuel system - Refer to [Fuel System Cleaning](#) .
 - Go to next step: If the fuel is not contaminated
3. Replace fuel injectors as indicated by high misfire counts.

Repair Instructions

Fuel Injector Replacement

Repair Verification

NOTE: Repair Verification requires cold start.

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 OFF the ignition for 60 seconds.
5. If the repair was 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 the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and perform the appropriate diagnostic procedure.

DTC P057B, P057C, P057D, OR P057E

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 P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B, P057E
5 V Reference	P057C P0651	P057C	P057D, P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. Normal Range: 0.25 - 4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the engine brake pedal override feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied. When the engine brake pedal override system is active, the ECM reduces engine torque to assist in reducing vehicle speed.

The BPP sensor is a six wire sensor, and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the engine brake pedal override feature. The BPP Sensor for engine brake pedal override communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit, and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to [Exterior Lighting Systems Description and Operation](#).

Conditions for Running the DTC

P057B

- DTCs P057C, or P057D are not set.
- Ignition voltage is greater than 10 V.
- Shift lever has been in Park at least once during key ON.
- Shift lever is not in Park.
- Vehicle speed is greater than 8 km/h (5 mph).
- Accelerator Pedal Position is less than 5%.
- DTC runs once per key cycle when above conditions are met.

P057C, P057D, or P057E

- Ignition voltage is greater than 10 V.
- DTC runs continuously when above condition is met.

Conditions for Setting the DTC

P057B

ECM detects the BPP sensor signal is stuck in a range for greater than 1 s.

P057C

ECM detects the BPP sensor voltage is less than 0.25 V for greater than 1 s.

P057D

ECM detects the BPP sensor voltage is greater than 4.75 V for greater than 1 s.

P057E

ECM detects the BPP sensor value varies greater than a calibrated value.

Action Taken When the DTC Sets

- P057B, P057C, P057D, and P057E are Type A DTCs.
- Brake Pedal Position Sensor parameter defaults to 0%.

Conditions for Clearing the DTC

P057B, P057C, P057D, and P057E are Type A DTCs.

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Exterior Lights Wiring Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

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

NOTE: The Brake Pedal Position sensor scan tool data is located in the ECM automatic transmission data list.

1. Ignition ON.
2. Verify DTC P0641, P0651, P0697, or P06A3 is not set.
 - If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **Go to next step: If none of the DTCs are set**

3. Transmission in Park, and service brake pedal released.

4. Verify the scan tool Brake Pedal Position Sensor parameter in the ECM displays greater than 0.25 V.

- **If 0.25 V or less**

Refer to Circuit/System Testing.

- **Go to next step: If greater than 0.25 V**

5. Verify the scan tool Brake Pedal Position Sensor parameter voltage changes as the brake pedal is applied and displays less than 4.75 V when the brake pedal is fully applied.

- **If the voltage does not change, or is greater than 4.74 V**

Refer to Circuit/System Testing.

- **Go to next step: If the voltage changes and less than 4.75 V**

6. Verify the scan tool Brake Pedal Position Sensor Learned Release Position parameter is within 0.1 V of the Brake Pedal Position Sensor parameter when the brake pedal is fully released.

- **If difference is greater than 0.1 V**

Perform the [Brake Pedal Position Sensor Calibration](#).

- **Go to next step: If difference is 0.1 V or less**

7. Verify the Brake Pedal Position Sensor parameter transitions smoothly without any spikes or dropouts when slowly applying and releasing the brake pedal.

- **If parameter does not transition smoothly or has spikes or dropouts**

Refer to Circuit/System Testing.

- **Go to next step: If parameter transitions smoothly and there are no spikes or dropouts**

8. 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.

9. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If the DTC does not set**

10. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification first.

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: All terminal references are for the vehicle harness brake pedal position sensor connector.

2. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.

- **If 10 Ω or greater**

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

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If less than 10 Ω**

3. Ignition ON.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 6 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance.

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

5. Verify the scan tool Brake Pedal Position Sensor parameter is less than 0.25 V.

- **If 0.25 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.

- If 0.25 V or greater, repair the short to voltage on the circuit.
- If less than 0.25 V, replace the K20 Engine Control Module.

- **Go to next step: If less than 0.25 V**

6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 6.

7. Verify the scan tool Brake Pedal Position Sensor parameter is greater than 4.8 V.

- **If 4.8 V or less**

1. Ignition OFF, remove the jumper wire, and disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 4 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If greater than 4.8 V**

8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Brake Pedal Position Sensor Replacement](#)
- Perform the [Crankshaft Position Variation Learn](#) following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- [Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P05CC OR P05CE

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 P05CC

Cold Start Intake Camshaft Position System Performance

DTC P05CE

Cold Start Exhaust Camshaft Position System Performance

Circuit/System Description

The camshaft position actuator system enables the engine control module (ECM) to change the timing of the camshafts while the engine is operating. The camshaft position actuator solenoid valves are each supplied a dedicated pulse width modulated (PWM) control circuit and low reference circuit from the ECM. The ECM operates each camshaft position actuator solenoid valve by controlling the amount of solenoid valve signal duty cycle to control the oil flow that applies the pressure to advance or retard the camshafts.

Conditions for Running the DTC

- DTC P0010, P0016, P0017, P0018, P0019, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390 or P0391, is not set.
- Ignition voltage is greater than 11 V.
- Engine is running.
- Desired camshaft position is greater than 0 degrees.
- Desired camshaft position is not changing greater than 4.5° for at least 1 s.
- Both of the desired and actual camshaft position actuator values cannot be greater than 20 degrees or less than 5 degrees.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects the difference between the desired and actual camshaft position angle is greater than 4.5 degrees for greater 1 s.

Action Taken When the DTC Sets

DTCs P05CC and P05CE are type B DTCs.

Conditions for Clearing the DTC

DTCs P05CC and P05CE are type B DTCs.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Component View Reference

Powertrain Component Views

Description and Operation

Camshaft Actuator 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

J 35616-200 Test Lamp Kit

Diagnostic Aids

- A low oil level or condition may set this DTC.
- Inspect the engine for any recent engine mechanical repairs. An incorrectly installed camshaft, camshaft actuator, or timing chain can cause this DTC to set.

Circuit/System Verification

NOTE:

- The engine oil level and the oil pressure are critical to the correct operation of the camshaft position actuator system. Verify that the engine has the correct oil level and the correct oil pressure before continuing with this diagnostic.
- The engine oil condition has a major impact on the camshaft actuator system. Debris in the oil can interfere with the camshaft position actuator solenoid and the mechanical camshaft actuator operation. Inspect for dirty or degraded crankcase oil. The engine may require an oil change. Inquire with the customer when the last oil change was performed. You may also monitor the scan tool Engine Oil Life Remaining parameter. Advise the customer an oil change may be required.

1. Verify the engine has the proper oil condition, level, and pressure. Refer to [Oil Pressure Diagnosis and Testing](#) .

- If the oil condition, level, and oil pressure are not correct

Repair as necessary

- Go to next step: If the oil condition, level, and oil pressure are correct

NOTE:

If a crankshaft or camshaft position sensor DTC is set, the scan tool Camshaft Position Actuator output control will not function.

2. Verify DTC P0010, P0016, P0017, P0018, P0019, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390 or P0391, is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **Go to next step: If none of the DTCs are set**

3. Engine Running at normal operating temperature.

4. Verify the scan tool parameters below are less than 2° in each of the commanded states when commanding the Camshaft Position Actuator from 0 - 20° and back to 0° .

- Intake Camshaft Position Variance
- Exhaust Camshaft Position Variance
- **If 2° or greater**

Refer to Circuit/System Testing.

- **Go to next step: If less than 2°**

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.

6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If the DTCs does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems Off, disconnect the appropriate harness connector at the Q6 Camshaft Position Actuator Solenoid Valve. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 or B and ground.

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If less than 5 Ω**

3. Ignition ON.

NOTE: A test lamp must be used for this test. The control circuit is pulled-up to a low current voltage, 1.5 - 4.5 V on the control circuit is normal.

4. Verify that a test lamp does not illuminate between the control circuit terminal 1 or A and ground.

- **If the test lamp illuminates**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If the test lamp does not illuminate**

5. Remove the test lamp.

6. Ignition ON.

7. Verify the scan tool Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status changes between OK and Not Run when commanding the Camshaft Position Actuator Solenoid Valve On and Off.

- **If the parameter does not change**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than $2\ \Omega$ in the control circuit end to end.

- If $2\ \Omega$ or greater, repair the open/high resistance or short to ground in the circuit.
- If less than $2\ \Omega$, replace the K20 Engine Control Module.
- **Go to next step: If the parameter changes**

NOTE: If debris is found on Q6 Camshaft Position Actuator Solenoid Valve screens, clean the screens and reinspect for damage. If the screens are not damaged, reinstall in the engine.

8. Ignition OFF, remove the Q6 Camshaft Position Actuator Solenoid Valve.

9. Verify the following conditions do not exist:

- Damaged, restricted, or missing screens on the Q6 Camshaft Position Actuator Solenoid Valve.
- Surface damage or an engine oil leak between the oil sealing lands of the Q6 Camshaft Position Actuator Solenoid Valve.
- Oil seepage at the Q6 Camshaft Position Actuator Solenoid Valve connector.
- **If a condition is found.**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **Go to next step: If a condition is not found**

NOTE: After exchanging the solenoids, install jumper wires to the appropriate terminals of the harness connectors and the solenoids.

10. Ignition OFF, exchange the suspect Q6 Camshaft Position Actuator Solenoid Valve with the Q6 Camshaft Position Actuator Solenoid Valve that is operating correctly.

11. Engine Running.

12. Verify the scan tool Camshaft Position Variance parameter is less than 2° in each of the commanded states when commanding the Camshaft Position Actuator from $0 - 20^\circ$ and back to 0° .

- **If 2° or greater**

Replace the mechanical camshaft position actuator.

- **Go to next step: If less than 2°**

13. Test or replace the Q6 Camshaft Position Actuator Solenoid Valve.

Component Testing

1. Ignition OFF, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve.

2. Test for 7-12 Ω between the control terminal 1 or A and the low reference circuit terminal 2 or B.

- **If not between 7-12 Ω**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **Go to next step: If between 7-12 Ω**

3. Test for infinite resistance between each terminal and the Q6 Camshaft Position Actuator Solenoid Valve housing.

- **If not infinite resistance**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **Go to next step: If infinite resistance**

4. All OK.

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Camshaft Position Actuator and Camshaft Replacement - Intake](#)
- [Camshaft Position Actuator and Camshaft Replacement - Exhaust](#)
- [Camshaft Position Actuator Exhaust Solenoid Valve Replacement](#)
- [Camshaft Position Actuator Intake Solenoid Valve Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0601, P0602, P0603, P0604, P0606, P062B, P062F, P0630, P064D, P16F3, OR P262B

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 of the 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 P064D

Control Module HO2S System Circuitry Performance

DTC P16F3

Control Module Redundant Memory Performance

DTC P262B

Control Module Power 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.

Conditions for Running the DTCs

P0601, P0602, P0630

These DTCs run continuously when the ignition is in ON.

P0603, P062F

These DTCs run once per ignition cycle.

P0604, P064D

DTC P0604 runs continuously when the ignition is ON for greater than 30 s.

P0606, P062B

These DTCs run continuously when Ignition 1 Signal voltage is greater than 11 V.

P16F3

- The engine speed is greater than 680 RPM.
- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P2227, P2228, P2229, or P2230 are not set.
- DTC P16F3 runs continuously when the above conditions are met.

P262B

DTC P262B runs during ECM power down.

Conditions for Setting the DTCs

The ECM detects an internal failure or incomplete programming for more than 10 s.

Actions Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P0630, and P16F3 are Type A DTCs.
- DTC P062F is a Type C DTC.
- DTCs P064D and P262B are Type B DTCs.

Conditions for Clearing the MIL/DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P0630, and P16F3 are Type A DTCs.
- DTC P062F is a Type C DTC.
- DTCs P064D and P262B are Type B DTCs.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify 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 Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Component View Reference

[Powertrain Component 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, clear the DTC information with a scan tool.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If no other DTCs are set**
3. Verify DTC P0602 or P0630 is not set.
 - **If any of the DTCs are set**
 1. Program the K20 Engine Control Module. Refer to [Control Module References](#) .
 2. Verify DTC P0602 or P0630 is not set.
 - If any of the DTCs are set, replace the K20 Engine Control Module.
 - Go to next step: If none of the DTCs are set
 - 3. All OK.
 - **Go to next step: If none of the DTCs are set**
4. Verify DTC P0601, P0603, P0604, P0606, P062B, P062F, P064D, P16F3, or P262B is not set.
 - **If any of the DTCs are set**
Replace the K20 Engine Control Module.
 - **Go to next step: If none of the DTCs are set**
5. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0627, P0628, OR 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 Descriptor

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
Control	P0171, P0506, P0628, P12A6	P0171, P0269, P0506, P0627, P0629, P12A6	P0629, P12A6	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The ECM enables the fuel pump driver 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 driver 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 greater than or equal to 11 V.
- The fuel pump enable circuit is commanded ON.
- 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 for 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 Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Powertrain Component Views

Description and Operation

Fuel 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. Ignition ON.
2. Verify that DTC P0627, P0628, or P0629 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.
 - **Go to next step: If a DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **Go to next step: If Malfunction is not displayed**
4. 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.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the K111 Fuel Pump Driver Control Module harness connector.
2. Ignition ON for 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.
 - **If the test lamp illuminates**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If Malfunction is displayed**
8. Test or replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Fuel Pump Power Control Module Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC P0641, P0651, P0697, P06A3, OR P06D2

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

DTC P06D2

5 V Reference 5 Circuit

Circuit/System Description

The engine control module (ECM) has 5 internal 5 V reference circuits. Each internal reference circuit provides external 5 V reference circuits for more than one sensor. A short to ground or short to voltage on one external 5 V reference circuit can affect all the components connected to the same internal 5 V reference circuit.

Conditions for Running the DTC

These DTCs run continuously when the ignition voltage is greater than 6.4 V.

Conditions for Setting the DTC

The ECM detects a short to ground or voltage on any of the 5 V reference circuits for greater than 0.5 s.

Action Taken When the DTC Sets

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

Diagnostic Aids

The 5 V reference 1 circuit provides 5 V circuits to the sensors listed below:

- Air conditioning (A/C) refrigerant pressure sensor
- Exhaust and intake camshaft position sensors
- Fuel pressure sensor
- Manifold absolute pressure sensor
- Vehicle stability control switch

The 5 V reference 2 circuit provides 5 V circuits to the sensors listed below:

- Brake booster vacuum sensor (with KL9 start/stop system)
- Brake pedal position sensor (automatic transmission)
- Crankshaft position sensor
- Engine oil pressure sensor
- Turbocharger boost/intake air temperature sensor

The 5 V reference 3 circuit provides 5 V circuits to the sensor listed below:

Accelerator pedal position sensor 2

The 5 V reference 4 circuit provides 5 V circuits to the sensors listed below:

- Accelerator pedal position sensor 1
- Throttle position sensor 1 and 2

The 5 V reference 5 circuit provides 5 V circuits to the sensor listed below:

- Fuel tank pressure sensor
- Multifunction intake air sensor

Disconnecting one component at a time from the affected 5 V reference circuit while observing the scan tool 5 V Reference Circuit Status parameter may help locate the fault. The scan tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all 5 V reference components have been disconnected and a fault is still indicated, the fault may exist in the wiring harness.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component 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.
2. Verify all scan tool 5 V Reference Circuit Status parameters do not display Malfunction.
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **Go to next step: If Malfunction is not displayed**
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.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
5. All OK.

Circuit/System Testing

NOTE: Additional DTCs will set when disconnecting the components.

1. Ignition OFF, disconnect the harness connector at all appropriate sensors for the applicable DTC.
Refer to Diagnostic Aids.
2. Ignition ON.

3. Test for 4.8 - 5.2 V between one of the 5 V reference circuits and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit for each applicable component and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.
2. Test for less than 1 V between the 5 V reference circuit for each applicable component and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

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

4. Verify the appropriate scan tool 5 V Reference 1, 2, 3, 4, or 5 Circuit Status parameter displays OK while connecting each component associated with the 5 V reference circuit one at a time.

- **If OK is not displayed when a component is connected**

Test the signal circuit of that component for a short to ground or voltage. If the circuit tests normal, replace the component.

- **Go to next step: If OK is displayed after all components have been connected**

5. All OK.

Repair Instructions

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

- **Accelerator Pedal with Position Sensor Assembly Replacement**
- **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (LTG)**
- **Brake Pedal Position Sensor Replacement**
- **Camshaft Position Sensor Replacement - Intake**
- **Camshaft Position Sensor Replacement - Exhaust**
- **Crankshaft Position Sensor Replacement**
- **Fuel Pressure Sensor Replacement - Fuel Feed Pipe**
- **Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement**
- **Automatic Transmission Input Speed Sensor Replacement** for transmission output shaft speed sensor replacement.
- **Intake Air Pressure and Temperature Sensor Replacement** for turbocharger boost/intake air temperature sensor replacement.
- **Manifold Absolute Pressure Sensor Replacement**
- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement**
- **Throttle Body Assembly Replacement**
- **Ride Control Switch Replacement - Center Console**
- **Control Module References** for engine control module replacement, programming, and setup.

DTC P0650, P263A, OR P263B

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

DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0650	P0650	-	-
Control	P0650, P263A*	P0650, P263A	P263B	-
* The MIL remains ON				

Circuit/System Description

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

Conditions for Running the DTC

- The engine speed is greater than 80 RPM.
- The ignition voltage is between 11 - 32 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

DTC P0650 or DTC P263A

The ECM detects low voltage during the MIL control circuit driver OFF state. This indicates either a shorted to ground or an open MIL control circuit.

DTC P263B

The ECM detects high voltage on the MIL control circuit during the driver ON state. This indicates a shorted to voltage MIL control circuit.

Action Taken When the DTC Sets

DTC P0650, P263A, and P263B are Type B DTCs.

Conditions for Clearing the DTC

DTC P0650, P263A, and P263B are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors while monitoring the scan tool MIL control circuit status parameters. Perform this test with the ignition ON and the

engine OFF, and with the engine running. The MIL control circuit status parameters change from OK or Not Run to Malfunction if there is a condition with a circuit or a connection.

- If the ECM detects low voltage on the MIL control circuit during the control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Instrument Cluster Wiring Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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.
2. Verify the parameters listed below do not display Malfunction when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **Go to next step: If Malfunction is not displayed**

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

Refer to Circuit/System Testing.

- **Go to next step: If Malfunction is not displayed**

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

Refer to Circuit/System Testing.

- **Go to next step: If the malfunction indicator lamp turns ON and OFF**

6. 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.

- **If the DTC sets**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **Go to next step: If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF.

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

3. Ignition ON, verify the malfunction indicator lamp does not illuminate.

- **If the malfunction indicator lamp illuminates**

1. Test for infinite resistance between the control circuit terminal X1 71 and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, replace the P16 Instrument Cluster.

- **Go to next step: If the malfunction indicator lamp does not illuminate**

4. Connect a 3 A fused jumper wire between the control circuit terminal X1 71 and ground.

5. Verify the malfunction indicator lamp illuminates.

- **If the malfunction indicator lamp illuminates**

Replace the K20 Engine Control Module.

- **If the malfunction indicator lamp does not illuminate**

1. Test for less than 1 V between the control circuit terminal X1 71 and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
- Go to next step: If less than 1 V

2. Ignition OFF.

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- Go to next step: If less than 2 Ω .

6. Ignition OFF, disconnect the harness connector at the instrument cluster.

7. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 8 and ground.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the ignition voltage circuit and ground.

- If less than infinite resistance, repair the short to ground in the circuit.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the ignition voltage circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- **Go to next step: If the test lamp illuminates**

8. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Instrument Cluster Replacement](#)
- [Control Module References](#) for control module replacement, programming, and setup

DTC P0685, P0686, P0687, P0689, P0690, OR P1682

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 P0686

Engine Controls Ignition Relay Control Circuit Low Voltage

DTC P0687

Engine Controls Ignition Relay Control Circuit High Voltage

DTC P0689

Engine Controls Ignition Relay Feedback Circuit Low Voltage

DTC P0690

Engine Controls Ignition Relay Feedback Circuit High Voltage

DTC P1682

Ignition 1 Switch Circuit 2

Diagnostic Fault Information

Engine Controls Ignition Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Relay Coil Supply Voltage	P0689, P1682	P0685, P0689, P1682	-
Relay Control Circuit	P0686, P0690	P0685, P0689, P1682	P0685, P0687, P0689, P1682
Relay Feedback Circuit	P0689, P1682	P0689, P1682	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
Operating Conditions: Component commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Malfunction	Malfunction	-

Circuit	Short to Ground	Open	Short to Voltage
Control	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
Operating Conditions: Component commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Not Run	Not Run	-
Control	Not Run	Not Run	Malfunction

Circuit/System Description

There are 2 ignition voltage circuits supplied to the engine control module (ECM). One is supplied by the engine controls ignition relay, and the other is supplied by the ignition main relay. The ECM monitors and compares the ignition voltage supplied by the 2 relays.

Conditions for Running the DTC

P0685, P0686, P0687

The DTC runs when Ignition 1 signal voltage is greater than 11 V.

P0689

- DTC P0685 is not set.
- The engine controls ignition relay is commanded ON.
- Ignition 1 signal voltage is greater than 11 V.
- The DTC runs continuously when the above conditions are met.

P0690

- DTC P0685 is not set.
- The engine controls ignition relay is commanded OFF.
- The DTC runs continuously when the above conditions are met.

P1682

- The engine controls ignition relay is commanded ON.
- Ignition voltage is greater than 5.5 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.

P0686

The ECM detects a short to ground on the control circuit for greater than 2 s.

P0687

The ECM detects a short to voltage on the control circuit for greater than 2 s.

P0689

The ECM detects the engine controls ignition relay feedback circuit is less than 5 V.

P0690

The ECM detects the engine controls ignition relay feedback circuit is greater than 4 V for greater than 5 s.

P1682

The ECM detects that the voltage level difference is greater than 3 V between the 2 ignition voltage circuits for greater than 1 s.

Action Taken When the DTC Sets

North American Emissions

- DTCs P0685, P0686, P0687, and P0690 are Type B DTCs.
- DTC P0689 is a Type C DTC.
- DTC P1682 is a Type A DTC.

European Emissions

- DTCs P0685, P0686, P0687, P0689, and P0690 are Type C DTCs.
- DTC P1682 is a Type A DTC.

Conditions for Clearing the DTC

North American Emissions

- DTCs P0685, P0686, P0687, and P0690 are Type B DTCs.
- DTC P0689 is a Type C DTC.
- DTC P1682 is a Type A DTC.

European Emissions

- DTCs P0685, P0686, P0687, P0689, and P0690 are Type C DTCs.
- DTC P1682 is a Type A DTC.

Diagnostic Aids

The engine controls ignition relay may also be labeled the powertrain relay, the engine control module relay, or the main relay. The ignition main relay may also be labeled the run/crank relay, the ignition run relay, the ignition 1 relay, or the ignition relay.

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Power Distribution Wiring Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views](#)
- [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 any other DTC is set, diagnose that DTC first.
- If you were sent here from Engine Cranks But Does Not Run, proceed to Circuit/System Testing.

1. Ignition ON, observe the scan tool DTC information. Verify DTC P0685, P0686, P0687, P0689, P0690, or P1682 is not set.

- If any of the DTCs are set

Refer to Circuit/System Testing.

- Go to next step: If none of the DTCs are set

2. 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.

- If any of the DTCs are set

Refer to Circuit/System Testing.

- Go to next step: If none of the DTCs are set

3. All OK.

Circuit/System Testing

NOTE:

You must perform the Circuit/System Verification before proceeding with Circuit/System Testing unless sent here from Engine Cranks But Does Not Run.

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.
2. Verify a test lamp illuminates between ground and the relay circuit terminals listed below:

- Terminal 85
- Terminal 30
- If the test lamp does not illuminate

Replace the front compartment fuse block.

- Go to next step: If the test lamp illuminates

NOTE:

- Go to next step: High resistance in the circuit/underhood fuse block for either the KR75 Engine Controls Ignition Relay or the KR73 Ignition Main Relay can cause DTC P1682 to set.

- **Go to next step: A short to voltage on any of the circuits supplied by the engine controls ignition relay can cause DTC P0690 to set.**

3. Ignition ON.

4. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 87 and ground.

- **If the test lamp illuminates**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.

2. Ignition ON.

3. Test for less than 1 V between ground and connector terminals 73.

- If 1 V or greater, repair the short to voltage in the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If the test lamp does not illuminate**

5. Ignition OFF, connect a 20 A fused jumper wire between the relay switch B+ circuit terminal 30 and the relay switch ignition voltage circuit terminal 87.

6. Ignition ON.

7. Verify the scan tool Engine Controls Ignition Relay Feedback Signal parameter displays B+.

- **If B+ is not displayed**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module

2. Test for less than 2 Ω in the relay switch ignition voltage circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- Go to next step: If less than 2 Ω

3. Test for infinite resistance between the relay switch ignition voltage circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **Go to next step: If B+ is displayed**

8. Ignition OFF, connect a DMM, set to the diode setting, between control circuit terminal 86 and ground.

9. Verify the DMM displays OL.

- **If OL is not displayed**

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

2. Test for infinite resistance between ground and the relay control circuit.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **Go to next step: If OL is displayed**

10. Ignition ON.

11. Verify the DMM displays less than 1 V.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X1 connector at the K20 Engine Control Module.

2. Ignition ON.

3. Test for less than 1 V on the relay control circuit.

- If 1 V or greater, repair the short to voltage on the circuit.
- Go to next step: If less than 1 V

4. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- if less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If less than 1 V**

12. Test or replace the KR75 Engine Controls Ignition Relay.

Relay Test

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.

2. Test for 70 - 110 Ω between terminals 85 and 86:

- **If less than 70 Ω or greater than 110 Ω**

Replace the relay.

- **Go to next step: If between 70 - 110 Ω**

3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- **If less than infinite resistance**

Replace the relay.

- **Go to next step: If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.

5. Test for less than 2 Ω between terminals 30 and 87.

- **If 2 Ω or greater**

Replace the relay.

- **Go to next step: If less than 2 Ω**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuse Block Replacement](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6, P10B7, P10B8, P10B9, P10BF, P10C6, P10C7, P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C, P128D, P128F, P129E, P12A8, P130F, P135C, P135D, P135E, P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4, P14D5, P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175E, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, OR P316B

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1201

Transmission Range Redundant Command Message Counter Incorrect

DTC P1000

Fuel Pump Driver Control Module Reset Count Message Counter Incorrect

DTC P1001

Evaporative Emission (EVAP) System Signals Message Counter Incorrect

DTC P1003

Fuel Composition Signals Message Counter Incorrect

DTC P1008

Engine Coolant Bypass Valve Command Signal Message Counter Incorrect

DTC P1009

Fuel Pump Driver Control Module Temperature High Signal Message Counter Incorrect

DTC P100A

Turbocharger Boost Control Signal Message Counter Incorrect

DTC P100E

Accelerator Pedal Position Signal Message Counter Incorrect

DTC P103D

Engine Coolant Pump Control Signal Message Counter Incorrect

DTC P103E

Auxiliary Coolant Pump Control Signal Message Counter Incorrect

DTC P10B6

Mass Air Flow Sensor Intake Air Signals Message Counter Incorrect Bank 1

DTC P10B7

Mass Air Flow Sensor Intake Air Signals Message Counter Incorrect Bank 2

DTC P10B8

Mass Air Flow Sensor Barometric Pressure Sensor Signal Message Counter Incorrect Bank 2

DTC P10B9

Mass Air Flow Sensor Barometric Pressure Sensor Signal Message Counter Incorrect Bank 1

DTC P10BF

Engine Coolant Bypass Valve Secondary Command Signal Message Counter Incorrect

DTC P10C6

Engine Diagnostic Status Signal Message Counter Incorrect

DTC P10C7

Reductant Control System Signal Message Counter Incorrect

DTC P10C8

Reductant Temperature Signal Message Counter Incorrect

DTC P10F5

EVAP Purge Pump Status Message Counter Incorrect

DTC P1100

Fuel Level Sensor 2 Signal Message Counter Incorrect

DTC P1103

Water in Fuel Signal Message Counter Incorrect

DTC P117A

Engine Block Coolant Valve Signal Message Counter Incorrect

DTC P11FF

Fuel Pump Command Signal Message Counter Incorrect

DTC P1200

Fuel Level Sensor 1 Signal Message Counter Incorrect

DTC P128C

Fuel Rail Temperature Sensor 1 Signal Message Counter Incorrect

DTC P128D

Fuel Rail Temperature Sensor 2 Signal Message Counter Incorrect

DTC P128F

Fuel Rail Pressure Sensors 1 and 2 Signals Message Counter Incorrect

DTC P129E

Fuel Pump Driver Control Module Signal Message Counter Incorrect

DTC P12A8

Fuel Pump Control Status Signal Message Counter Incorrect

DTC P130F

Ignition On/Start Voltage Signal Message Counter Incorrect

DTC P135C

Cooling Fan 1 Status Signals Message Counter Incorrect

DTC P135D

Cooling Fan 2 Status Signals Message Counter Incorrect

DTC P135E

Cooling Fan 3 Status Signals Message Counter Incorrect

DTC P135F

Cooling Fan 4 Status Signals Message Counter Incorrect

DTC P1436

Particulate Matter Sensor Control Module Temperature Signal Message Counter Incorrect

DTC P143A

Reductant Control System Diagnostic Signal Message Counter Incorrect

DTC P143B

Reductant Control System Information Signal Message Counter Incorrect

DTC P1472

Particulate Matter Sensor Signal Message Counter Incorrect

DTC P14A0

Charge Air Cooler Coolant Pump Status Signal Message Counter Incorrect

DTC P14B6

Mass Air Flow Sensor Signal Message Counter Incorrect

DTC P14BD

Mass Air Flow Sensor Signal Message Counter Incorrect Bank 2

DTC P14CD

Fuel Pump Driver Control Module Configuration Command Signal 1 Message Counter Incorrect

DTC P14CE

Fuel Pump Driver Control Module Configuration Status Signal Message Counter Incorrect

DTC P14D4

Fuel Pump Driver Control Module Configuration Command Signal 2 Message Counter Incorrect

DTC P14D5

Fuel Pump Driver Control Module Configuration Command Signal 3 Message Counter Incorrect

DTC P14D6

Fuel Pump Driver Control Module Configuration Command Signal 5 Message Counter Incorrect

DTC P150C

Transmission Control Module Engine Speed Request Signal Message Counter Incorrect

DTC P151A

Throttle Actuator Control (TAC) Signal Message Counter Incorrect

DTC P151D

Transmission Control Module Engine Shutdown Request Signal Message Counter Incorrect

DTC P153C

Engine Speed Signal Message Counter Incorrect

DTC P153D

Driver Torque Request Signal Message Counter Incorrect

DTC P155D

Hill Descent Control Message Counter Incorrect

DTC P1591

Body Control Module Engine Speed Request Signal Message Counter Incorrect

DTC P15E2

Alternative Fuel System Request Signal Message Counter Incorrect

DTC P15F2

Engine Torque Command Signal Message Counter Incorrect

DTC P15F9

Hybrid/EV System Engine Speed Control Intervention Request Type Signal Message Counter Incorrect

DTC P15FA

Wheel Slip Status Signal Message Counter Incorrect

DTC P15FB

Brake Pedal Position Sensor Signal Message Counter Incorrect

DTC P165C

Sensor Reference Voltage Status Message Counter Incorrect

DTC P167F

Battery Voltage Signal Message Counter Incorrect

DTC P16E8

Engine Controls Ignition Relay Signal Message Counter Incorrect

DTC P16FF

Engine Controls Ignition Relay Request Signal Message Counter Incorrect

DTC P175F

Acceleration Sensor Signal Message Counter Incorrect

DTC P1761

Up and Down Shift Switch Signal Message Counter Incorrect

DTC P1762

Transmission Mode Switch Signal Message Counter Incorrect

DTC P1775

Transmission Range Request Signal Message Counter Incorrect

DTC P179B

Transmission Range State Command Signal Message Counter Incorrect

DTC P189C

Transmission Range Command Message Performance

DTC P2544

Transmission Torque Request Signal Message Counter Incorrect

DTC P30B4

NOx Sensor 1 Signal Message Counter Incorrect

DTC P30B5

NOx Sensor 2 Signal Message Counter Incorrect

DTC P30BC

Particulate Matter Sensor Control Module Status Signal Message Counter Incorrect

DTC P30BD

Engine Stall Prevention Active Signal Message Counter Incorrect

DTC P30D5

NOx Sensor 3 Signal Message Counter Incorrect

DTC P30DE

Fuel Rail Pressure Sensor 2 Signal Message Counter Incorrect

DTC P3168

Fuel Injector Set 2 Commands Signal Message Counter Incorrect

DTC P3169

Fuel Injector Control Module Commands Signal Message Counter Incorrect

DTC P316B

Secondary Fuel System Requests Signal Message Counter Incorrect

Circuit/System Description

Control modules connected to the serial data circuits monitor the communication during normal vehicle operation. Operating information and commands are exchanged among the control modules. Each module on the serial data circuit maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and decrease with error-free messages.

Conditions for Running the DTC

- Ignition = On - For greater than 3 s
- Serial Data = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Serial Data = Message Counter Incorrect - Control module that has set the DTC

The above condition(s) must occur 5 times.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type C DTC

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify there are no DTCs set related to the following system/component: Serial Data
 - **If a related DTC is set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**
3. Clear the DTCs.
 4. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- **If the DTC sets**
 1. Ignition/Vehicle - Off
 2. Replace the component: The control module that is sending the error message.
 3. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- If the DTC sets

Replace the component: Control module that has set the DTC

 - Go to next step: If the DTC does not set
4. All OK.
 - **Go to next step: If the DTC does not set**
 5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P1255

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 P1255**Fuel Pump Control Module Driver High Temperature****Circuit/System Description**

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

Conditions for Running the DTC

- The ignition voltage is between 7 - 32 V.
- The engine is cranking or running.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The fuel pump driver control module detects a driver temperature greater than 302°F (150°C) for less than 0.5 s.

Action Taken When the DTC Sets

DTC P1255 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1255 is a Type A DTC.

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 Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel 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. Ignition ON.
2. Verify DTC P0231, P0232, or P023F is not set.
 - **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - **Go to next step: If none of the DTCs are set**
3. Verify that the area where the K111 Fuel Pump Driver Control Module is located is free of debris, clutter, or any insulating material that would cause the fuel pump driver control module to overheat.
 - **If any debris, clutter, or other material is found**
 1. Clear the area where the K111 Fuel Pump Driver Control Module is located.
 2. Clear the DTC and test drive the vehicle.
 3. Verify DTC P1255 is not set.
 - If DTC P1255 is set, replace the K111 Fuel Pump Driver Control Module.
 - Go to next step: If DTC P1255 is not set
 4. All OK.
 - **Go to next step: If no debris, clutter, or other material is found**
4. Clear the DTC and test drive the vehicle.
5. Verify DTC P1255 is not set.
 - **If DTC P1255 is set**

Replace the K111 Fuel Pump Driver Control Module.
 - **Go to next step: If DTC P1255 is not set.**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Fuel Pump Power Control Module Replacement

DTC P127C, P128A, P128B, P16E4, OR P16E5

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 P127C

Fuel Rail Pressure Sensor 2 Circuit Low Voltage

DTC P128A

Fuel Rail Pressure Sensor 1 Internal Performance

DTC P128B

DTC P16E4

Sensor Communication Circuit 3 Low Voltage

DTC P16E5

Sensor Communication Circuit 3 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0236, P0237, P0340, P0345, P0365, P0390, P0452, P0522, P0532, P0641, P06D2, P16E5	P16E4, P16E5	P0121, P018D, P0236, P0641, P06D2, P1400, P16E5, P2227, P222B	-
Signal	P16E4	P16E5	P128F, P16E5	-
Low Reference	-	P16E5	-	-

Typical Scan Tool Data**Fuel Rail Pressure Sensor**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating with the throttle closed. All accessories OFF. Parameter Normal Range: Fuel Rail Pressure Sensor 3.0 - 4.2 MPa			
5 V Reference	655.4 MPa	655.4 MPa	3.1 MPa
Signal	0.4 MPa	655.4 MPa	655.4 MPa
Low Reference	-	655.4 MPa	-

Fuel Rail Pressure Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating with the throttle closed. All accessories OFF. Parameter Normal Range: Fuel Rail Pressure Sensor 3.9 - 4.2 MPa			
5 V Reference	655.4 MPa	655.4 MPa	655.4 MPa
Signal	655.4 MPa	655.4 MPa	655.4 MPa
Low Reference	-	655.4 MPa	-

Circuit/System Description

The fuel rail pressure sensor transmits fuel pressure and temperature information by serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The fuel rail pressure sensor internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor. The engine control module (ECM) supplies the fuel rail pressure sensor with a 5 V reference circuit, a low reference circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the fuel rail pressure sensor to the ECM. The ECM decodes the serial data signal into separate voltages which are displayed on a scan tool as the voltage inputs from the Fuel Temperature Sensor, Fuel Rail Pressure Sensor and Fuel Rail Pressure Sensor 2.

Conditions for Running the DTC**P128A or P128B**

- DTC P128F, P16E4 or P16E5 is not set.
- Ignition is ON.
- The DTCs run continuously when the above condition are met.

P127C, P16E4 or P16E5

- Ignition is ON.
- No DTC clear code
- The DTCs run continuously when the above condition are met.

Conditions for Setting the DTC

P127C

The engine control module detects the fuel pressure sensor 2 SENT digital read value is less than or equal to 94 for greater than 1 s.

P128A

The engine control module detects fuel pressure sensor 1 SENT digital read value is greater than 4, 089 for greater than 1 s

P128B

The engine control module detects fuel pressure sensor 2 SENT digital read value is greater than 4, 089 for greater than 1 s

P16E4

The engine control module detects fuel pressure sensor SENT signal shorted low for greater than 1 s

P16E5

The engine control module detects fuel pressure sensor SENT signal shorted high for greater than 1 s

Action Taken When the DTC Sets

DTCs P127C, P128A, P128B, P16E4 and P16E5 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P127C, P128A, P128B, P16E4 and P16E5 are Type A DTCs.

Diagnostic Aids

A high resistance condition on the fuel rail pressure sensor circuits could cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Fuel 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. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC P0641, P0651, P0697, P06A3, or P06D2 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If none of the DTCs are set**
3. Verify that DTC P0182, P0183, P0187, P0188, P111F, P126E, P126F, P128A, or P128B are not set.
 - **If DTC P128A or P128B are the only DTCs set**
Test or replace the B310 Fuel Pressure/Temperature Sensor.
 - **If DTC P0183, P0184, P0187, P0188, P111F, P126E, P126F, P127C, P16E4, or P16E5 is set with any of the DTCs**
Refer to Circuit/System Testing.
 - **Go to next step: If none of the DTCs are set**
4. 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.
5. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
6. All OK.

[Circuit/System Testing](#)

NOTE: Disconnecting the fuel rail pressure sensor harness connector causes additional DTCs to set.

1. Ignition/Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at B310 Fuel Pressure/Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

6. Replace the B310 Fuel Pressure/Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement](#) for B310 Fuel Pressure/Temperature Sensor.
- [Control Module References](#) for control module replacement, programming, and setup.

DTC P129D

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 P129D

Fuel Pump Driver Control Module Ignition 1 Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P129D	P129D	-	-

Circuit/System Description

The fuel pump driver control module monitors the ignition voltage circuit in order to determine if the voltage is within the normal operating range.

Conditions for Running the DTC

The DTC runs continuously when the modules are awake.

Conditions for Setting the DTC

The fuel pump driver control module Power Mode does not agree with the engine control module (ECM) Power Mode for 1 s.

Action Taken When the DTC Sets

DTC P129D is a Type A DTC.

Conditions for Clearing the DTC

DTC P129D is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel 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. Ignition ON.
2. Verify DTC P129D is not set.

- **If the DTC is set**

Refer to Circuit/System Testing.

- **Go to next step: If the DTC is not set**

3. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify DTC P0562 is not set.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

3. Ignition OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module, ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp, and disconnect all components on the circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 3. Replace the fuse, ignition ON.
 4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.
 - If the fuse is good, all OK.
 - **Go to next step: If the test lamp illuminates**
5. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Fuel Pump Power Control Module Replacement

DTC P12A6

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 P12A6

Fuel Pump Driver Control Module Enable Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0171, P0506, P0628, P12A6	P0171, P0506, P12A6	P12A6	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The control module enables the fuel pump driver 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 driver 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 ignition voltage is greater than 7 V.
- The DTC runs continuously when the condition above is met.

Conditions for Setting the DTC

The ECM state of the fuel pump enable circuit does not match the state of the fuel pump enable circuit sensed by the fuel pump driver control module for 0.5 s.

Action Taken When the DTC Sets

DTC P12A6 is a Type A DTC.

Conditions for Clearing the DTC

DTC P12A6 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel 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. Ignition ON.
2. Verify that DTC P12A6 is not set.
 - **If the DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC is not set**

3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **Go to next step: If Malfunction is not displayed**
4. 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.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
2. Ignition ON for 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If Malfunction is displayed**
8. Replace the K111 Fuel Pump Driver Control Module.

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Fuel Pump Power Control Module Replacement](#)
- [Control Module References](#) for ECM replacement, setup, and programming

DTC P135A

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 P135A

Ignition Coil Supply Voltage Circuit Bank 1

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A	P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A	-	-

Circuit/System Description

The ignition system uses an individual ignition coil for each cylinder. The engine control module (ECM) monitors the ignition voltage from the fuse to the individual coils.

Conditions for Running the DTC

- Delay starting at ignition On for 5 engine revolutions.
- Ignition Run/Crank relay voltage is greater than 5 V
- PT relay voltage is greater than 11 V

The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects less than 2.5 V on the ignition coil supply voltage circuit.

Action Taken When the DTC Sets

DTC P135A is a Type B DTC.

Conditions for Clearing the DTC

DTC P135A is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

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

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Ignition Coil Supply Voltage parameter displays ON.
 - **If ON is not displayed**

Refer to Circuit/System Testing.
 - **Go to next step: If ON is displayed**
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.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a 3 A fused jumper wire between the control circuit terminal 67 and ground, ignition ON.
3. Verify a test lamp illuminates between the ignition circuit terminal 51 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.

1. Ignition OFF, remove the test lamp, and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
3. Replace the fuse, ignition ON.
4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.

- If the fuse is good, all OK.
 - **Go to next step: If the test lamp illuminates**
4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition Coil Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P1400

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](#) provide an overview of each diagnostic category.

DTC Descriptor

DTC P1400

Cold Start Emission Reduction Control System

Circuit/System Description

The catalyst must be warmed to efficiently reduce the emissions. The cold start strategy is to reduce the amount of time it takes to warm the catalyst. During a cold start, the engine spark timing is altered to allow the catalyst to warm quickly. This diagnostic monitors the following to build an exhaust energy model:

- Spark advance
- Engine airflow
- Engine coolant temperature
- Engine run time

The actual model is then compared to the expected exhaust energy model.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0201, P0202, P0203, P0204, P0222, P0223, P0300, P0301, P0302, P0303, P0304, P0335, P0336, P0351, P0352, P0353, P0354, P0641, P0651, P0697, P06A3, P2122, P2123, P2127, P2128, P2135, and P2138 are not set.
- The engine coolant temperature (ECT) is between -12 to +56°C (10 - 132°F).
- The calculated 3-way catalyst temperature is colder than 500°C (932°F).
- The barometric (BARO) pressure is greater than 75 kPa.
- The engine control module (ECM) will exit the diagnostic if the calculated 3-way catalyst temperature is greater than 1,000°C (1832°F) when the engine run time is greater than 17 s.
- Vehicle speed is less than 1.6 km/h (1 mph).
- The accelerator pedal is not depressed.
- The ECM will exit the diagnostic if the engine run time is greater than a calibrated value.
- This DTC runs within the first 15 s of start-up. This diagnostic runs once per trip when a cold start has been determined.

Conditions for Setting the DTC

The actual exhaust energy model does not match the expected exhaust energy model.

Action Taken When the DTC Sets

DTC P1400 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1400 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. Vehicle OFF, allow the engine to cool to be within the temperatures listed in the Conditions for Running the DTC.
2. Engine running.
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.
4. Verify the DTC does not set.

- **If the DTC sets**

1. Verify that none of the conditions listed below exists with the air intake system:

- Damage, restriction, or modification
- Dirty or deteriorating air filter element
- Crankcase ventilation system for correct operation
- Water intrusion
- Vacuum leak and other unmetered air downstream of the mass air flow (MAF) sensor
- Intake manifold leak
- If any of the conditions exist

Repair as necessary.

- Go to next step: If none of the conditions exist

2. Verify that none of the conditions listed below exists with the exhaust system:

- Exhaust leak
- Damaged, restricted, or modified exhaust system - Refer to [Symptoms - Engine Exhaust](#) .

- If any of the above conditions exist

Repair as necessary.

- Go to next step: If none of the conditions exist

3. If all of the above conditions test normal, inspect for an engine mechanical condition that could alter the air flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#).

- **Go to next step: If the DTC does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1516, P2101, P2119, OR P2176

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 P1516

Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance

DTC P2101

Throttle Actuator Position Performance

DTC P2119

Throttle Closed Position Performance

DTC P2176

Minimum Throttle Position Not Learned

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
TAC Motor Control Closed	P1516, P2101	P1516, P2101	P1516, P2101	P0690, P1516, P2101	P1516, P2101, P2176
TAC Motor Control Open	P1516, P2101, P2119	P1516, P2101	P1516, P2101	P0690, P1516, P2101	P1516, P2101, P2176

Circuit/System Description

The Throttle Body Assembly contains a contact-less inductive throttle position sensing element that is managed by a customized integrated circuit. The throttle position sensor is mounted within the Throttle Body Assembly and is not serviceable. The Engine Control Module (ECM) supplies the throttle body with a 5 V reference circuit, a low reference circuit, an H-bridge motor directional control circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the throttle body to the ECM. The throttle body cannot receive data from the ECM over the signal/serial data circuit. The throttle position sensor provides a signal voltage that changes relative to throttle blade angle. The customized integrated circuit translates the voltage based position information into serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble

Transmission (SENT) protocol. The throttle position sensor information is transmitted between the throttle body and the ECM on the signal/serial data circuit. The ECM decodes the serial data into a representation of voltage signals that are occurring in the throttle body. The information is then displayed on a scan tool as the voltage inputs from TP sensors 1 and 2.

The ECM controls the throttle valve by applying a varying voltage to the control circuits of the throttle actuator control (TAC) motor. The ECM monitors the duty cycle that is required to actuate the throttle valve. The ECM monitors the throttle position sensor signal/serial data circuit to determine the actual throttle valve position.

Conditions for Running the DTC

P1516

- DTC P0606, P1682 is not set.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- DTC P1516 runs continuously when the above conditions are met.

P2101

- DTC P0606, P1682 is not set.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The engine is running or the following conditions are met:
 - The engine is not running.
 - The ignition voltage is greater than 11 V.
 - The TAC system is not in the Battery Saver mode.
 - The ECM is commanding the throttle.
 - The ECM has learned the minimum throttle position.
- DTC P2101 runs continuously when the above conditions are met.

P2119

- DTCs P0122, P0123, P0222, P0223, or P06A3 is not set.
- The run/crank or powertrain relay voltage is greater than 5.5 V and reduced power is not active.
- The system is not in the Battery Save mode.
- The ECM is not commanding the throttle.
- DTC P2119 runs continuously when the above conditions are met.

P2176

- The run/crank or powertrain relay voltage is greater than 6.4 V and reduced power is not active.
- DTC P2176 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P1516

The ECM detects an unstable throttle position for greater than 1 s.

P2101

- The ECM detects the actual throttle position does not match the predicted throttle position for greater than 1 s.

OR

- The ECM detects the throttle control is driving the throttle in the incorrect direction or exceed the reduced power limit.

P2119

The ECM determines that the throttle blade did not return to the rest position within 1 s.

P2176

The ECM detects that both throttle position sensors were greater than a predetermined voltage during the minimum throttle learn procedure for greater than 2 s.

Action Taken When the DTC Sets

- DTC P1516 is a Type B DTC.
- DTCs P2101 and P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.
- The ECM commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions, the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- DTC P1516 is a Type B DTC.
- DTCs P2101 and P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.

Diagnostic Aids

- Depending on the Start Up ECT, the Desired Throttle Position percentage maybe greater or less than the Throttle Position with the TAC motor at rest. When the ignition is initially turned ON, or when the engine is cranking or running the Desired and Actual Throttle positions should closely match.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close.
- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- A low battery condition may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Throttle Actuator Control (TAC) 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

Circuit/System Verification

1. Ignition ON.

NOTE: A low battery voltage or charging system condition may cause a DTC to set.

2. Verify DTC P0121, P0122, P0123, P0222, P0223, P0562, P0621, P0622, or P2135 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- Go to next step: If none of the DTCs are set

3. Verify the scan tool Throttle Body Idle Air flow Compensation parameter is less than 90%.

- If 90% or greater

Refer to [Throttle Body Cleaning](#) .

- Go to next step: If less than 90%

4. Clear the DTCs with a scan tool.

5. Ignition OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.

6. Ignition ON.

7. Verify the scan tool TAC Motor parameter displays Enabled while slowly depressing the accelerator pedal.

- If Enabled is not displayed

Refer to Circuit/System Testing.

- Go to next step: If Enabled is displayed

8. Verify DTC P1516, P2101, P2119, or P2176 is not set.

- If any of the DTCs are set

Refer to Circuit/System Testing.

- Go to next step: If none of the DTCs are set

NOTE: If there is a condition with the throttle body, the TAC Motor Command parameter will go to 99% for a predetermined amount of time and then a DTC sets. Once a DTC is set, the TAC Motor Command parameter will go to 0% and the TAC Motor parameter will display Disabled.

9. Verify the scan tool TAC Motor parameter displays Enabled while performing the Throttle Sweep Test with a scan tool.

- If Enabled is not displayed

Test or replace the Q38 Throttle Body Assembly.

- Go to next step: If Enabled is displayed

10. 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.

11. Verify the DTC does not set.

- If the DTC sets

Refer to Circuit/System Testing.

- Go to next step: If the DTC does not set

12. All OK.

Circuit/System Testing

1. Ignition OFF.

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

2. Verify the conditions listed below do not exist with the Q38 Throttle Body:

NOTE:

- The rest position is defined as the actual Throttle Position percentage when the ignition is OFF or with the ignition ON for greater than 30 seconds.
- When the ignition is OFF, spring tension should hold the throttle plate in the rest position. You should be able to open the throttle plate to wide open throttle (WOT) or push the throttle plate to the fully closed position. In each case, the throttle plate should return to the rest position without assistance.

- A throttle blade that is not in the rest position
- A throttle blade that is binding open or closed
- A throttle blade that is free to move open or closed without spring pressure
- If a condition is found

Replace the Q38 Throttle Body.

- Go to next step: If a condition is not found

NOTE: Disconnecting the throttle body harness connector may cause additional DTCs to set.

3. Disconnect the harness connector at the Q38 Throttle Body Assembly, ignition ON.

NOTE: The test lamp may illuminate briefly when the ignition switch is turned on, but should not remain illuminated.

4. Verify that a test lamp does Not illuminate continuously between each motor control circuit listed below and ground.

- TAC Motor Control Closed circuit terminal 1
- TAC Motor Control Open circuit terminal 2
- If the test lamp is always ON

1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module, ignition ON

2. Test for less than 1 V between the motor control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- Go to next step: If the test lamp is always OFF

5. Verify that a test lamp does not illuminate between each motor control circuit listed below and B+.

- TAC Motor Control Closed circuit terminal 1
- TAC Motor Control Open circuit terminal 2
- If the test lamp illuminates

1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

• **Go to next step: If the test lamp does not illuminate**

6. Ignition OFF, set the DMM to the 40 V scale, select the Min/Max Recording Mode, and set the Peak Min/Max response time to 1 ms.

NOTE:

- **The test lamp must be connected to circuit before turning ignition on or incorrect diagnosis may occur.**
- **The ignition must be OFF and the ECM completely powered down before testing each circuit or a lower voltage will be recorded. It may take up to 2 min for all vehicle systems to power down.**
- **The DMM Min/Max Recording Mode and the response time of 1 ms must be reset after testing each circuit or a lower voltage will be recorded.**

7. Verify the Max voltage is within 3 V of B+ while using DMM Min/Max Recording Mode function on each control circuit listed below as the ignition is turned ON.

- TAC Motor Control Closed circuit terminal 1
- TAC Motor Control Open circuit terminal 2
- **If not within 3 V of B+**

1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module.

2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

• **Go to next step: If within 3 V of B+**

8. Replace the Q38 Throttle Body.

Repair Instructions

- [Throttle Body Assembly Replacement](#)
- [Control Module References](#) for ECM replacement, programming, and setup

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.
5. Ignition ON.
6. Verify the scan tool TAC Motor parameter displays Enabled while performing the Throttle Sweep Test with a scan tool.

- **If Enabled is not displayed**

Test or replace the Q38 Throttle Body Assembly.

- **Go to next step: If Enabled is displayed**

7. If the repair was 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 set.

- **If DTC sets**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- Go to next step: If DTC does not set

8. All OK.

DTC P163A

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 P163A

Control Module Fuel Pressure Regulator 1 Control System Circuitry Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM) or an out of range high pressure fuel pump actuator current.

Conditions for Running the DTC

- DTC P0016, P0017, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0191, P0192, P0193, P0335, P0336, P0340, P0341, P0365, P0366, P0628, or P1682 is not set.
- The engine is running.
- The ignition voltage is greater than 11 V.
- The low side fuel pressure is greater than 250 kPa (36 psi).
- The barometric (BARO) pressure is greater than 70 kPa.
- The intake air temperature (IAT) is warmer than -20Â°C (-4Â°F).
- DTC P163A runs continuously when the conditions are met for greater than 500 mS.

Conditions for Setting the DTC

The ECM detects a condition with the integrated circuits of the high pressure fuel pump actuator driver module or the ECM detects that the current used to drive the high pressure fuel pump actuator is greater than 11 A or less than 0.1 A for greater than 4 s.

Action Taken When the DTC Sets

DTC P163A is a Type B DTC.

Conditions for Clearing the DTC

DTC P163A is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Fuel 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 Testing](#)

1. Ignition OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump.

NOTE: The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.

2. Test for 0.3 - 0.7 Ω at 20 $\hat{A}$ °C (68 $\hat{A}$ °F) between the high control circuit terminal 1 and the low control circuit terminal 2 on the G18 High Pressure Fuel Pump.
 - **If not between 0.3 - 0.7 Ω**
Replace the G18 High Pressure Fuel Pump.
 - **Go to next step: If between 0.3 - 0.7 Ω**
3. Test for infinite resistance between each terminal on the G18 High Pressure Fuel Pump and the G18 High Pressure Fuel Pump housing.
 - **If less than infinite resistance**
Replace the G18 High Pressure Fuel Pump.
 - **Go to next step: If infinite resistance**
4. Ignition ON, verify that a test lamp does not illuminate between the high control circuit terminal 1 and ground and the low control circuit terminal 2 and ground at the ECM side of the harness connector.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the harness connector at the ECM, ignition ON.
 2. Test for less than 1 V between the appropriate control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
5. Verify that a test lamp does not illuminate between the high control circuit terminal 1 and B+ and the low control circuit terminal 2 and B+.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the harness connector at the ECM.
 2. Test for infinite resistance between the appropriate control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
6. Connect a 3 A fused jumper wire between the high control circuit terminal 1 and ground.

7. Verify the Fuel Pressure Regulator High Control Circuit Open Test Status transitions from Malfunction to OK and the Fuel Pressure Regulator High Control Circuit Low Voltage Test Status transitions from OK to Malfunction.

- **The parameters do not change**

1. Ignition OFF, disconnect the harness connector at the ECM.
2. Test for less than 2 Ω in the high control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: The parameters change**

8. Connect a 3 A fused jumper wire between the low control circuit terminal 2 and B+.
9. Verify the Fuel Pressure Regulator Control Circuit Open Test Status transitions from Malfunction to OK and the Fuel Pressure Regulator Control Circuit High Voltage Test Status transitions from OK to Malfunction.

- **The parameters do not change**

1. Ignition OFF, disconnect the harness connector at the ECM.
2. Test for less than 2 Ω in the low control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: The parameters change**

10. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Fuel Pump Replacement](#)
- [Control Module References](#) for engine control module replacement, setup, and programming
- Perform the Fuel Rail Pressure Relief Valve Reset procedure, if supported on the scan tool.

DTC P16A7, P16AF, OR P16B3

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 P16A7

Engine Controls Ignition Relay Feedback Circuit 2

DTC P16AF

Engine Controls Ignition Relay Feedback Circuit 2 Low Voltage

DTC P16B3

Engine Controls Ignition Relay Feedback Circuit 2 High Voltage

Diagnostic Fault Information

Engine Controls Ignition Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Relay Coil Supply Voltage	P0689, P1682, P16A7, P16AF, P16BC	P0685, P0689, P1682, P16A7, P16AF, P16BC	-
Relay Control Circuit	P0686, P0690, P16B3, P16BF	P0685, P0689, P1682, P16A7, P16AF, P16BC	P0685, P0687, P0689, P1682, P16A7, P16AF, P16BC
Relay Feedback Circuit	P0689, P1682, P16A7, P16AF, P16BC	P0689, P1682, P16A7, P16AF, P16BC	P0690, P16B3, P16BF

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
Operating Conditions: Component commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Malfunction	Malfunction	-
Control	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
Operating Conditions: Component commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Not Run	Not Run	-
Control	Not Run	Not Run	Malfunction

Circuit/System Description

There are 3 ignition voltage circuits supplied to the engine control module (ECM). Two are supplied by the engine controls ignition relay, and the other is supplied by the ignition main relay. The ECM monitors and compares the ignition voltage supplied by the 2 relays.

Conditions for Running the DTC

P16A7

- The engine controls ignition relay is commanded ON.
- Ignition voltage is greater than 5.5 V.
- The DTC runs continuously when the above conditions are met.

P16AF

- The engine controls ignition relay is commanded ON.
- Ignition 1 signal voltage is greater than 11 V.
- The DTC runs continuously when the above conditions are met.

P16B3

The DTC runs when the engine controls ignition relay is commanded OFF.

Conditions for Setting the DTC

P16A7

The ECM detects that the voltage level difference is greater than 3 V between the engine controls ignition relay feedback circuit 2 and the ignition 1 signal circuit for greater than 1 s.

P16AF

The ECM detects the engine controls ignition relay feedback circuit 2 is less than 5 V.

P16B3

The ECM detects the engine controls ignition relay feedback circuit 2 is greater than 4 V for greater than 5 s.

Action Taken When the DTC Sets

- DTC P16A7 is a Type A DTC.
- DTC P16AF is a Type C DTC.
- DTC P16B3 is a Type B DTC.

Conditions for Clearing the DTC

- DTC P16A7 is a Type A DTC.
- DTC P16AF is a Type C DTC.
- DTC P16B3 is a Type B DTC.

Diagnostic Aids

The engine controls ignition relay may also be labeled the powertrain relay, the engine control module relay, or the main relay. The ignition main relay may also be labeled the run/crank relay, the ignition run relay, the ignition 1 relay, or the ignition relay.

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Power Distribution Wiring Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views](#)

- [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 P16B3 to set. If any other DTC is set, diagnose that DTC first.**
- **If you were sent here from Engine Cranks But Does Not Run, proceed to Circuit/System Testing.**

1. Ignition ON, observe the scan tool DTC information. Verify DTC P16A7, P16AF, or P16B3 is not set.

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

Refer to Circuit/System Testing.

- **Go to next step: If none of the DTCs are set**

2. 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.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If the DTC does not set**

3. All OK.

[Circuit/System Testing](#)

NOTE:

You must perform the Circuit/System Verification before proceeding with Circuit/System Testing unless sent here from Engine Cranks But Does Not Run.

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.

2. Verify a test lamp illuminates between ground and the B+ terminals listed below:

- Terminal 85
- Terminal 30
- **If the test lamp does not illuminate**

Replace the front compartment fuse block.

- **Go to next step: If the test lamp illuminates**

NOTE:

- **Go to next step: High resistance in the circuit/underhood fuse block for either the KR75 Engine Controls Ignition Relay or the KR73 Ignition Main Relay can cause DTC P16A7 to set.**
- **Go to next step: A short to voltage on any of the circuits supplied by the engine controls ignition relay can cause DTC P16B3 to set.**

3. Ignition ON.

4. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 87 and ground.

- **If the test lamp illuminates**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Ignition ON.
3. Test for less than 1 V between ground and connector terminal 73.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **Go to next step: If the test lamp does not illuminate**

5. Ignition OFF, connect a 20 A fused jumper wire between the B+ circuit terminal 30 and the ignition voltage circuit terminal 87.

6. Ignition ON.

7. Verify the scan tool Engine Controls Ignition Relay Feedback Signal parameter displays B+.

- **If B+ is not displayed**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module
2. Test for less than 2 Ω in the relay switch ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - Go to next step: If less than 2 Ω
3. Test for infinite resistance between the relay switch ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **Go to next step: If B+ is displayed**

8. Ignition OFF, connect a DMM, set to the diode setting, between control circuit terminal 86 and ground.

9. Verify the DMM displays OL.

- **If OL is not displayed**

1. Disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between ground and the relay control circuit.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **Go to next step: If OL is displayed**

10. Ignition ON.

11. Verify the DMM displays less than 1 V.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X1 connector at the K20 Engine Control Module.
2. Ignition ON.
3. Test for less than 1 V on the relay control circuit.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - if less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If less than 1 V**

12. Test or replace the KR75 Engine Controls Ignition Relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.
2. Test for 70 - 110 Ω between terminals 85 and 86:

- **If less than 70 Ω or greater than 110 Ω**

Replace the KR75 Engine Controls Ignition Relay.

- **Go to next step: If between 70 - 110 Ω**

3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- **If less than infinite resistance**

Replace the KR75 Engine Controls Ignition Relay.

- **Go to next step: If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.

5. Test for less than 2 Ω between terminals 30 and 87.

- **If 2 Ω or greater**

Replace the KR75 Engine Controls Ignition Relay.

- **Go to next step: If less than 2 Ω**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Relay Replacement \(Attached to Wire Harness\)](#), [Relay Replacement \(Within an Electrical Center\)](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P2096 OR P2097

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 P2096

Post Catalyst Fuel Trim System Low Limit

DTC P2097

Post Catalyst Fuel Trim System High Limit

Circuit Description

Fuel trim bias is used to keep the post catalyst air/fuel ratio within a predetermined range. This allows optimal catalyst efficiency under various operating conditions. The engine control module (ECM) constantly monitors how lean or rich the fuel trim bias is commanded, to determine if the fuel trim bias is greater than a calibrated amount.

Conditions for Running the DTC

- DTC P0016, P0017, P0030, P0036, P0053, P0054, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P015A, P015B, P0178, P0179, P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P111E, P1133, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P219A, P2227, P2228, P2229, P2230, P2269, P2270, P2271, P2440, P2444, or P2A00 is not set.
- The barometric pressure (BARO) is greater than 70 kPa (10.2 PSI).
- The manifold absolute pressure (MAP) is between 0 - 200 kPa (0 - 29 PSI).
- The intake air temperature (IAT) is between -20°C and +200°C (-4 and +392°F).
- The start up engine coolant temperature is warmer than -20°C (-4°F).
- The fuel control intrusive diagnostics are not active.
- The engine is operating under light acceleration, heavy acceleration, or cruise conditions.
- DTCs P2096 and P2097 run continuously when the conditions above have been met.

Conditions for Setting the DTC

The correction limit for a condition causing a lean or rich air/fuel ratio has been exceeded.

Action Taken when the DTC Sets

DTCs P2096 and P2097 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P2096 and P2097 are Type B DTCs.

Diagnostic Aids

- The post catalyst fuel trim diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component 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

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify no other HO2S or fuel trim DTC is set.
 - **If any other HO2S or fuel trim DTC is set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If no other HO2S or fuel trim DTC is set**
3. Verify DTC P2096 or P2097 is not set.
 - **If a DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
5. Verify DTC P2096 or P2097 is not set.
 - **If a DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If no DTC is set**
6. All OK.

Circuit/System Testing

Inspect for the conditions listed below:

P2096

- Air intake duct collapsed or restricted.
- Air filter dirty or restricted.
- Objects blocking the throttle body.
- Excessive fuel in the crankcase. Change engine oil as necessary.
- Rich fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- Excessive fuel system pressure. Refer to [Fuel System Diagnosis](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Fuel saturation of the evaporative emissions (EVAP) canister
- Stuck open or leaking EVAP purge valve
- Restricted exhaust. Refer to [Symptoms - Engine Exhaust](#).
- Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#).

P2097

- Exhaust system leaks. Refer to [Symptoms - Engine Exhaust](#).
- Split, kinked, or improperly connected vacuum hoses
- Insufficient fuel in the tank
- Leaks in the air induction system and air intake ducts
- Missing air filter element
- Cracked evaporative canister
- Evaporative pipes plugged, obstructed, or leaking

- Crankcase ventilation system leaking. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#).
- Engine vacuum leaks
- Low fuel system pressure. Refer to [Fuel System Diagnosis](#).
- Contaminated fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Lean fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- If a condition is found

Repair as necessary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P2122, P2123, P2127, P2128, OR P2138

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](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC P2122

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

DTC P2123

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

DTC P2127

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

DTC P2128

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

DTC P2138

Accelerator Pedal Position (APP) Sensors 1-2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
APP Sensor 1 5 V Reference	P06A3	P2138	P2122	P06A3	P2138
APP Sensor 2 5 V Reference	P0108, P0697	P2138	P2127	P0107, P0522, P0532, P0697	P2138
APP Sensor 1 Signal	P2122	P2138	P2122	P2123	P2138
APP Sensor 2 Signal	P2127	P2138	P2127	P2128	P2138
APP Sensor 1 Low Reference	-	P2138	P2123	-	P2138

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
APP Sensor 2 Low Reference	-	P2138	P2128	-	P2138

Typical Scan Tool Data

APP Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating at idle. Parameter Normal Range: APP Sensor 1 0.88 - 1.08 V			
APP Sensor 1 5 V Reference	0.00 V	0.00 V	2 - 4 V
APP Sensor 1 Signal	0.00 V	0.00 V	4 - 5 V
APP Sensor 1 Low Reference	-	4 - 5 V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating at idle. Parameter Normal Range: APP Sensor 2 0.39 - 0.59 V			
APP Sensor 2 5 V Reference	0.00 V	0.00 V	1 - 3 V
APP Sensor 2 Signal	0.00 V	0.00 V	2 - 5 V
APP Sensor 2 Low Reference	-	4 - 5 V	-

Circuit/System Description

The accelerator pedal assembly contains 2 accelerator pedal position (APP) sensors. The APP sensors are mounted to the accelerator pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to pedal position. The engine control module (ECM) supplies each APP sensor with a 5 V reference circuit, a low reference circuit, and a signal circuit.

Conditions for Running the DTC

P2122, P2123, P2127, P2128

- DTC P0697 or P06A3 is not set.
- The ignition is ON or the engine is running.
- The run/crank or powertrain relay voltage is greater than 6.0 V and reduced power is not active.
- DTC P2122, P2123, P2127, P2128 run continuously when the above conditions are met.

P2138

- DTC P0697, P06A3, P2122, P2123, P2127, and P2128 are not set.
- The ignition is ON or the engine is running.
- The run/crank or powertrain relay voltage is greater than 6.0 V and reduced power is not active.
- DTC P2138 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

The ECM detects the APP sensor 1 voltage is less than 0.46 V for greater than 1 s.

P2123

The ECM detects the APP sensor 1 voltage is greater than 4.75 V for greater than 1 s.

P2127

The ECM detects the APP sensor 2 voltage is less than 0.32 V for greater than 1 s.

P2128

The ECM detects the APP sensor 2 voltage is greater than 2.6 V for greater than 1 s.

P2138

The ECM detects the voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, P2128, and P2138 are Type A DTCs.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

DTCs P2122, P2123, P2127, P2128, and P2138 are Type A DTCs.

Diagnostic Aids

A high resistance condition on the accelerator pedal sensor circuits could cause a DTC to set.

Ensure that the in-line harness connector seals are installed correctly. Improper installation could result in water intrusion into the connector and cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Throttle Actuator Control (TAC) 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. Ignition ON.
2. Verify DTC P0697 or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697, P06A3, or P06D2** for further diagnosis.

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool APP Sensor 1 Circuit Status and APP Sensor 2 Circuit Status parameters display OK.

- **If OK is not displayed**

Refer to Circuit/System Testing.

- **Go to next step: If OK is displayed**

4. Verify the scan tool APP Sensor 1 and 2 Agree/Disagree parameter displays Agree while performing the tests listed below:

- Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times.
- Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat the procedure several times.

- **If Disagree**

Refer to Circuit/System Testing

- **Go to next step: If Agree**

5. Verify that DTC P2122, P2123, 2127, P2128, or P2138 is not set.

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

Refer to Circuit/System Testing

- **Go to next step: If none of the DTCs set**

6. 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.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **Go to next step: If the DTC does not set**

8. All OK

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B107 Accelerator Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the appropriate low reference circuit terminal listed below and ground.

- APP sensor 1 low reference circuit terminal 4
- APP sensor 2 low reference circuit terminal 5

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If less than 5 Ω**

3. Ignition ON.

4. Test for 4.8 - 5.2 V between the appropriate 5 V reference circuit terminal listed below and ground.

- APP sensor 1 5 V reference circuit terminal 2
- APP sensor 2 5 V reference circuit terminal 1
- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If between 4.8 - 5.2 V**
5. Verify the scan tool APP sensor 1 and APP sensor 2 voltage parameters are less than 0.3 V.
 - **If 0.3 V or greater**
 - 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit terminal listed below and ground.
 - APP sensor 1 signal circuit terminal 3
 - APP sensor 2 signal circuit terminal 6
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If less than 0.3 V**
6. Install a 3 A fused jumper wire between the appropriate signal circuit terminal listed below and the 5 V reference circuit terminal 1.
 - APP sensor 1 signal circuit terminal 3
 - APP sensor 2 signal circuit terminal 6
7. Verify the scan tool APP sensor 1 or APP sensor 2 voltage parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 - 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the signal circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 - 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If greater than 4.8 V**
8. Test or replace the B107 Accelerator Pedal Position Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Accelerator Pedal with Position Sensor Assembly Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P2199

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 P2199

Intake Air Temperature (IAT) Sensor 1-2 Not Plausible

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P0114, P2199	P0111, P0113, P0114, P2199	P0113*, P0114, P2199	P0111, P2199
Low Reference	-	P0113, P2199, P2227, P2229	P0113*, P0114	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F4, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102, P2199	-	P0096
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient humidity, temperature, and engine bay conditions			
Ignition Voltage	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz 0%	-
Signal	-40Â°C (-40Â°F) 10 Hz 100%	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz* 0%

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Ground	-	-40Â°C (-40Â°F) 10 Hz 0%	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F).

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- BARO pressure sensor

IAT Sensor 1 - Temperature, Resistance, Voltage Table

IAT Sensor 1	IAT Sensor 1 Resistance	IAT Sensor 1 Signal Voltage
Cold	High	High
Warm	Low	Low

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	45 Hz	-40Â°C (-40Â°F)
Warm	302 Hz	104Â°C (219Â°F)

Conditions for Running the DTC

- The ignition is ON.
- Ignition 1 voltage is at least 11 V.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

The ECM detects that the absolute difference between the IAT sensor 1 and the IAT sensor 2 temperatures is greater than 55Â°C (99Â°F) for longer than 5 s.

Action Taken When the DTC Sets

DTC P2199 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P2199 is a Type B DTC.

Diagnostic Aids

- With the ignition ON, the engine OFF, if the engine is cold, a properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40Â°C (-40Â°F), and there are Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Ignition On.
2. Verify that DTC DTC P0097, P0098, P0099, P00F4, P00F5, P00F6, P0102, P0103, P0112, P0113, P0114, P0641, P0651, P0697, P06A3 or P06D2 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If none of the DTCs are set**
3. Ignition ON.
4. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **Go to next step: If within 30°C (54°F)**

5. Engine running, verify the following scan tool parameters are between: -38 and +149°C (-36 and +300°F).

- IAT Sensor 1
- IAT Sensor 2
- **If not between: -38 and +149°C (-36 and +300°F)**

Refer to Circuit/System Testing.

- **Go to next step: If between: -38 and +149°C (-36 and +300°F)**

6. 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.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If the DTC does not set**

8. All OK

Circuit/System Testing

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

1. Check the integrity of the entire air induction system and verify that none of the following conditions exist:

- A restricted or collapsed air intake duct
- An intake manifold leak
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- **If a condition exists**

Repair or replace component as appropriate.

- **Go to next step: If no condition exists**

2. Ignition Off, and all vehicle systems Off, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module.

- **Go to next step: If less than 5 Ω**

4. Test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. Ignition Off.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.

- **Go to next step: If less than 5 Ω**

5. Ignition On.

6. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition Off, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.
 2. Test for less than $2\ \Omega$ in the ignition voltage circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition Off, remove the test lamp and remove the fuse for the ignition voltage circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
 - **Go to next step: If a test lamp illuminates**
7. Verify the scan tool Intake Air Temperature Sensor 1 parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F).**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If colder than -39°C (-38°F).**
8. Ignition Off, install a 3 A fused jumper wire between the IAT 1 signal circuit terminal 1 and the low reference circuit terminal 3.
9. Ignition On.
10. Verify the scan tool Intake Air Temperature Sensor 1 parameter is warmer than 148°C (298°F).
 - **If colder than 148°C (298°F).**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Ignition On.
 3. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
 4. Ignition Off.
 5. Test for less than $2\ \Omega$ in the signal circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **Go to next step: If warmer than 148°C (298°F).**
11. Ignition On.

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage near B+ can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

12. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.
 - **If 1% or greater**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If less than 1%**

13. Ignition Off, install a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3.

14. Ignition On.

15. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.

- **If 99% or less**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Ignition Off, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module.

2. Ignition On.

3. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- Go to next step: If less than 1 V.

4. Ignition Off.

5. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **Go to next step: If greater than 99%**

16. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Ignition Off, disconnect the harness connector at the B75C Multifunction Intake Air Sensor.

2. Connect a DMM between the IAT sensor 1 signal terminal 1 and the low reference terminal 3

NOTE: A thermometer can be used to test the sensor off the vehicle.

3. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor](#) table for Hitachi Sensors. The resistance values should be in range of the table values.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **Go to next step: If within the specified range**

4. All OK.

Multifunction Intake Air Sensor

1. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **Go to next step: If within the specified range**

2. All OK.

Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Ignition Off, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50% (Normal)
 - Frequency switch to 250 Hz
4. Ignition On.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
 - IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76°C (160 - 166°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

Replace the K20 Engine Control Module.

- **Go to next step: If all the parameters are within the specified range**

6. All OK.

Repair Instructions

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

- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** for multifunction intake air sensor replacement
- **Control Module References** for engine control module replacement, programming, and setup.

DTC P219A

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 P219A

Fuel Trim Cylinder Balance

Circuit/System Description

The Fuel Trim Cylinder Balance diagnostic detects a rich or lean cylinder to cylinder air/fuel ratio imbalance. The diagnostic monitors the pre-catalyst heated oxygen sensor (HO2S) signal's frequency and amplitude characteristics by calculating an accumulated voltage over a predetermined sample period. An imbalance is indicated when multiple samples of the accumulated voltage are consistently higher than the desired value.

Conditions for Running the DTC

- DTCs P0016, P0017, P0030, P0036, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0019, P0122, P0123, P0128, P0131-P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0171, P0172, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301-P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0455, P0458, P0496, P111E, P1133, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2270, P2271, P2440, P2444 or P2A00 are not set.
- The evaporative emission system device control and intrusive diagnostics are not active.
- The engine overspeed protection is not active.
- The engine is in closed loop status.
- The system voltage is greater than 11 V.
- The engine coolant temperature (ECT) is warmer than -20Â°C (-4Â°F).
- The engine speed is between 1, 200 - 4, 000 RPM.
- The mass air flow is between 0 - 100 g/s.
- The secondary air injection pump (if equipped) is not ON.
- The Exhaust Camshaft Position and Intake Camshaft Position are between 0 - 35 degrees.
- Engine run time is greater than 30 s.
- Fuel level is greater than 10% and no fuel level sensor fault is present.
- The DTC runs continuously when the above conditions have been met.

Conditions for Setting the DTC

Multiple samples of the pre-catalyst HO2S accumulated voltage are consistently greater than the desired value.

Action Taken When the DTC Sets

DTC P219A is a Type A DTC.

Conditions for Clearing the MIL/DTC

DTC P219A is a Type A DTC.

Diagnostic Aids

- The fuel trim cylinder balance diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Monitoring the misfire current counters, or misfire graph, may help to isolate the cylinder that is causing the condition.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

- [Circuit Testing](#)
- [Troubleshooting with a Test Lamp](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Connector 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.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If no other DTCs are set**
3. Verify DTC P219A is not set.
 - **If a DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
5. Verify DTC P219A is not set.
 - **If a DTC is set**
Refer to Circuit/System Testing.
 - **Go to next step: If no DTC is set**
6. All OK.

Circuit/System Testing

1. Engine idling, transmission in Park or Neutral, verify the manifold absolute pressure (MAP) sensor parameter is between 20 - 48 kPa.
 - **If not within the specified range .**
Refer to [DTC P0106](#) .
 - **Go to next step: If within the specified range, inspect for the conditions listed below:**
 - Modified, damaged, leaking, or restricted air induction system components.
 - Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
 - Split, kinked, or improperly connected vacuum hoses.
 - Restricted, damaged, leaking, or modified exhaust system from the catalytic converter forward. Refer to [Symptoms - Engine Exhaust](#) .
 - Improperly operating fuel injectors. Refer to [Fuel Injector Diagnosis](#).
 - Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).

- Excessive fuel in the crankcase due to leaking injectors. Change engine oil as necessary.
- Improperly operating ignition system. Refer to [Electronic Ignition System Diagnosis](#).
- **If a condition is found**

Repair as necessary.

- **Go to next step: If no condition is found**

2. Test the engine for any mechanical conditions such as sticking valves, lifters, etc., which could alter the flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#).

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P2227, P2228, P2229, OR P2230

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 P2227

Barometric Pressure (BARO) Sensor Performance

DTC P2228

Barometric Pressure (BARO) Sensor Circuit Low Voltage

DTC P2229

Barometric Pressure (BARO) Sensor Circuit High Voltage

DTC P2230

Barometric Pressure (BARO) Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0651, P2227, P2228	P2228	P0651, P2229	P2227
Signal	P2227, P2228	P2227, P2228	P2227, P2229	P2227
Low Reference	-	P2227, P2229	-	P2227

Typical Scan Tool Data

BARO

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On, Engine Off Parameter Normal Range: 56 - 105 kPa (8.1 - 15.2 psi), varies with altitude			
5 V Reference	0 kPa (0 psi)	0 kPa (0 psi)	127 kPa (18.4 psi)
Signal	0 kPa (0 psi)	0 kPa (0 psi)	127 kPa (18.4 psi)

Circuit	Short to Ground	Open	Short to Voltage
Low Reference	-	127 kPa (18.4 psi)	-

Circuit/System Description

The barometric pressure (BARO) sensor is integral to the multifunction intake air sensor and responds to changes in altitude and atmospheric conditions. This gives the ECM an indication of barometric pressure. The ECM uses this information to calculate fuel delivery. The BARO sensor provides a voltage signal to the ECM relative to the atmospheric pressure changes. The ECM monitors the BARO sensor signal for a voltage outside of the normal range.

Conditions for Running the DTC

P2227

- Engine is running.
 - DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P0236, P0237, P0238, P1516, P2101, P2135, P2228, or P2229 is not active.
 - DTC P2227 runs continuously when the above conditions are met.

OR

- Ignition is On, engine is Off for at least 10 s.
 - DTC P0106, P0107, P0108, P0236, P0237, P0238, P2228, P2229, P2230, or P2610 is not active.
 - DTC P0107, P0108, P0237, P0238, P2228, or P2229 is not pending.
 - DTC P2227 runs continuously when the above conditions are met.

P2228 or P2229

- Engine is running.
- The DTCs run continuously when the above condition is met.

P2230

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P0236, P0237, P0238, P1516, P2101, P2135, P2228, or P2229 is not set.
- Ignition is On
- DTC P2230 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2227

- The engine is running.
 - The ECM detects that the difference between the actual BARO and the calculated BARO is greater than 15 kPa when the distance traveled since the last calculated BARO update is less than or equal to 0.1 km (0.06 mi).

OR

- The ECM detects that the difference between the actual BARO and the calculated BARO is greater than 20 kPa when the distance traveled since the last calculated BARO update is greater than 0.1 km (0.06 mi).

OR

- Ignition On, engine Off

- The ECM detects that the BARO pressure is less than 50 kPa (7.3 psi) or greater than 115 kPa (16.7 psi).

OR

- The ECM detects that the absolute value of the difference between MAP and actual BARO is greater than 10 kPa and the absolute value of the difference between Boost Pressure and MAP is less than or equal to 10 kPa and the absolute value of the difference between Boost Pressure and BARO is greater than 10 kPa.

P2228

The ECM detects that the BARO sensor voltage is less than 1.7 V for greater than 5 s.

P2229

The ECM detects that the BARO sensor voltage is greater than 4.5 V for greater than 5 s.

P2230

The ECM detects that the cumulative difference between BARO sensor readings, over a specific length of time, is greater than a calibrated threshold.

Action Taken When the DTC Sets

- P2227, P2228, P2229, and P2230 are Type B DTCs with emission package RPOs NT7, NU5, and NQL.
- P2227, P2228, P2229, and P2230 are Type C DTCs with emission package RPOs NE4 and NE9.

Conditions for Clearing the MIL/DTC

- P2227, P2228, P2229, and P2230 are Type B DTCs with emission package RPOs NT7, NU5, and NQL.
- P2227, P2228, P2229, and P2230 are Type C DTCs with emission package RPOs NE4 and NE9.

Diagnostic Aids

A skewed boost pressure sensor (Turbocharger Boost/Intake Air Temperature Sensor) may cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

Circuit/System Verification

1. Ignition On.
2. Verify the scan tool BARO parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.
 - **If the BARO is not within the specified range**
Refer to Circuit/System Testing.
 - **Go to next step: If the BARO is within the specified range**
3. Verify the scan tool Boost Pressure parameter and the BARO parameter are within 3 kPa (0.43 PSI).
 - **If not within 3 kPa (0.43 PSI)**
Refer to [DTC P0236](#).
 - **Go to next step: If within 3 kPa (0.43 PSI)**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Verify the conditions listed below do not exist with the B75C Multifunction Intake Air Sensor:
 - Damage
 - Restrictions in the inlet port
 - **If a condition exists**
Repair or replace the B75C Multifunction Intake Air Sensor as necessary.
 - **Go to next step: If none of the conditions exist**
2. Ignition Off, and all vehicle systems Off, it may take up to 2 min for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air Sensor.
3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.
 - **If 5 Ω or greater**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If greater than the specified value, repair the open or high resistance in the circuit.
 - If 2 Ω or less replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
4. Ignition On.
5. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **Go to next step: If infinite resistance**
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module, ignition On.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If between 4.8 - 5.2 V**
- 6. Verify the scan tool BARO Sensor parameter is greater than 4.7 V.
 - **If 4.7 V or less**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If greater than 4.7 V**
- 7. Connect a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 2.
- 8. Verify the scan tool BARO Sensor parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, ignition On.
 2. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V.
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 0.2 V**
- 9. Test or replace the B75C Multifunction Intake Air Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P2261

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 P2261

Turbocharger Bypass Valve Stuck

Circuit/System Description

The dual-scroll turbocharger incorporates a wastegate that is controlled by the engine control module (ECM) by means of a pulse width modulation (PWM) solenoid, to regulate the pressure ratio of the compressor. An ECM controlled compressor bypass valve is integrated into the unit to prevent compressor surging and damage from vibrations by opening during abrupt closed throttle conditions. The bypass valve is open during closed throttle deceleration conditions to allow air to recirculate in the turbocharger and maintain compressor speed.

Conditions for Running the DTC

- DTC P0033, P0034, P0035, P0101, P0102, P0103, P0236, P0237, or P0238 is not set.
- Engine speed is at least 1,500 RPM
- The boost pressure versus the BARO pressure ratio is between 1.1 - 3.3.
- The turbocharger bypass valve has been commanded Open greater than 6% for greater than 1 s immediately after an abrupt closed throttle has occurred and the resulting pressure ratio across the compressor exceeds the calibrated pressure ratio limit.
- The DTC runs continuously when the above conditions have been met.

Conditions for Setting the DTC

The ECM has detected a series of pulsations in the induction system that exceed a calibrated threshold.

Action Taken When the DTC Sets

- P2261 is a Type B DTC with emission package RPOs NT7, NU5, and NQL.
- P2261 is a Type C DTC with emission package RPOs NE4 and NE9.

Conditions for Clearing the MIL/DTC

- P2261 is a Type B DTC with emission package RPOs NT7, NU5, and NQL.
- P2261 is a Type C DTC with emission package RPOs NE4 and NE9.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Turbocharger 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. Ignition On.

2. Verify that DTC P0033, P0034, or P0035 is not set

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

Refer to [DTC P0033-P0035](#).

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool BARO Sensor parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table for the current testing altitude.

- **If the parameter is not within the range specified in the table.**

Refer to [DTC P2227-P2230](#).

- **Go to next step: If the parameter is within the range specified in the table.**

4. Verify the scan tool Boost Pressure Sensor and BARO Sensor parameters are within 3 kPa (0.4 psi).

- **If the parameters are not within 3 kPa (0.4 psi).**

Refer to [DTC P0236](#).

- **Go to next step: If the parameters are within 3 kPa (0.4 psi).**

5. Verify a click is heard or felt from the Q40 Turbocharger Bypass Solenoid Valve when commanding the Turbocharger Bypass Solenoid Valve between Active and Inactive with a scan tool.

- **If a click is not heard or felt**

Refer to Circuit/System Testing

- **Go to next step: If a click is heard or felt**

6. 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.

7. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing

- **Go to next step: If a DTC does not set**

8. All OK

Circuit/System Testing

NOTE: Leave harness connector connected or re-connect it after removing valve.

1. Ignition Off, remove the Q40 Turbocharger Bypass Solenoid Valve from the turbocharger, ignition On.

2. Verify the turbocharger bypass valve plunger retracts and extends when commanding the Turbocharger Bypass Solenoid Valve between Active and Inactive with a scan tool.

- **The valve plunger does not retract and extend**

Replace the Q40 Turbocharger Bypass Solenoid Valve

- **Go to next step: The valve plunger retracts and extends**

3. Verify the conditions listed below do not exist with the turbocharger assembly. Refer to [Camshaft Cover and Compressor Air Intake Turbocharger Cleaning and Inspection](#)

- Cracked, damaged or worn turbine blades
- Restricted wastegate, turbine, ports or passages
- Foreign material
- **If a condition exists**

Repair or replace the turbocharger as necessary

- **Go to next step: If none of the conditions exist**

4. Replace the Q40 Turbocharger Bypass Solenoid Valve

Component Testing

Static Test

1. Ignition Off, disconnect the harness connector at the Q40 Turbocharger Bypass Solenoid Valve.
2. Test for 10 - 14 Ω between the control terminal 2 and the Ignition terminal 1 of the Q40 Turbocharger Bypass Solenoid Valve.

- **If not between 10 - 14 Ω**

Replace the Q40 Turbocharger Bypass Solenoid Valve.

- **Go to next step: If between 10 - 14 Ω**

3. All OK

Dynamic Test

1. Install a 10 A fused jumper wire between the ignition terminal 2 of the Q40 Turbocharger Bypass Solenoid Valve and 12 V. Install a jumper wire between the control terminal 1 and ground.
2. Verify the Q40 Turbocharger Bypass Solenoid Valve plunger retracts.

- **If the plunger does not retract.**

Replace the Q40 Turbocharger Bypass Solenoid Valve.

- **Go to next step: If the plunger retracts.**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Turbocharger Bypass Valve Solenoid Replacement

DTC P2618 OR P2619

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P2618

Crankshaft Position Signal Output Circuit Low Voltage

DTC P2619

Crankshaft Position Signal Output Circuit High Voltage

Conditions for Running the DTC

- Ignition Voltage = Greater than 11 V
- Ignition = On
- Crankshaft Position Sensor Circuit = Active

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P2618

Crankshaft Position Signal Output Circuit = Short to Ground or Open - For greater than 5 s

P2619

Crankshaft Position Signal Output Circuit = Short to Voltage - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type C DTC

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Engine - Running
2. Verify there are no DTCs/symptoms related to the following system/component, if equipped:
 - K71 Transmission Control Module
 - K103 Fuel Injector Control Module
 - T3 Audio Amplifier
 - T6 Power Inverter Module
 - **If a DTC or symptom exists**

Refer to:
 - [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - [Symptoms - Vehicle](#)
 - **Go to next step: If no DTC or symptom exists**
3. All OK.

DTC P2635

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 P2635

Fuel Pump Flow Performance

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump power control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump power control module remains active for 2 s, unless the engine is in crank or run. While this voltage is being received, the fuel

pump power control module closes the ground switch of the fuel pump. The fuel pump power control module maintains correct fuel pressure based on the information from the fuel pressure sensor and varying the Pulse Width Modulation (PWM) controlled current to the fuel pump.

Conditions for Running the DTC

- DTC P018B, P018C, P018D, P0231, P0232, P023F, P0641, P064A, P0606, P1255, P129E, or P12A6 are not active.
- Fuel pump control is enabled and the fuel pump control state is normal.
- The ignition voltage is between 11 - 32 V.
- The engine has been running for more than 30 s.
- The engine fuel flow is not 0.
- Low fuel level warning not present.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The fuel pump power control module detects a difference of $\hat{A} \pm 60$ kPa (8.7 PSI) at 400 kPa (58 PSI) request or $\hat{A} \pm 45$ kPa (6.5 PSI) at 300 kPa (43.5 PSI) request between the desired fuel pressure and the actual fuel pressure for approximately 10 s.

Action Taken When the DTC Sets

DTC P2635 is a Type B DTC.

Conditions for Clearing the DTC

DTC P2635 is a Type B DTC.

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.

On vehicles equipped with a high pressure mechanical pump on Direct Fuel Injection engines, the vehicle may continue to run even though the pump in the fuel tank is not operating.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Fuel 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. Ignition ON.
2. Verify DTC U0074 or U18A2 is not set or stored in history.
 - **If DTC U0074 or U18A2 is set or stored in history**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If DTC U0074 or U18A2 is not set or stored in history**
3. Verify that DTC P018B, P018C, P018D, P0231, P0232, or P023F is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If none of the DTCs are set**
4. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.
 - **If greater than 1.5**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 1.5**
5. Command the Fuel Pressure to 300 kPa (43.5 PSI) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
6. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 45 kPa (6.5 PSI) of each other at 300 kPa (43.5 PSI) request.
 - **If greater than 45 kPa (6.5 PSI)**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 45 kPa (6.5 PSI)**
7. Command the Fuel Pressure to 400 kPa (58 PSI) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
8. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 60 kPa (8.7 PSI) of each other at 400 kPa (58 PSI) request.
 - **If greater than 60 kPa (8.7 PSI)**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 60 kPa (8.7 PSI)**
9. 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.
10. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
11. All OK.

NOTE: Do not replace the fuel pump power control module based on a history DTC P2635. DTC P2635 may be stored but that does not indicate a failure of the fuel pump power control module. Refer to [Strategy Based Diagnosis](#) for further history DTC diagnostics.

1. Verify the proper fuel system pressure. Refer to [Fuel System Diagnosis](#).

- **If the fuel pressure is not normal**

Repair the fuel system as necessary.

- **Go to next step: If the fuel pressure is normal**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Feed Front Pipe Replacement](#)
- [Fuel Feed Pipe Replacement](#)
- [Fuel Injector Replacement](#)
- [Fuel Tank Fuel Pump Module Replacement](#)
- Perform the Fuel Pump Trim Reset procedure with a scan tool after the repair.

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn OFF the ignition for 60 s.
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.
 - **If greater than 1.5**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 1.5**
7. Command the Fuel Pressure to 300 kPa (43.5 PSI) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
8. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 45 kPa (6.5 PSI) of each other at 300 kPa (43.5 PSI) request.
 - **If greater than 45 kPa (6.5 PSI)**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 45 kPa (6.5 PSI)**
9. Command the Fuel Pressure to 400 kPa (58 PSI) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
10. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 60 kPa (8.7 PSI) of each other at 400 kPa (58 PSI) request.
 - **If greater than 60 kPa (8.7 PSI)**
Refer to Circuit/System Testing.
 - **Go to next step: If less than 60 kPa (8.7 PSI)**

SYMPTOMS - ENGINE CONTROLS

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** provide an overview of each diagnostic category.

Symptoms Description

Symptoms covers conditions that are not covered by DTCs. Certain conditions can cause multiple symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause specific symptoms are listed separately under Additional Symptoms Testing. Perform the Symptoms Testing before using the Additional Symptoms Testing.

Symptoms Definition

Backfire

The Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Cuts Out, Misses

A steady pulsation or jerking that follows engine speed, which is usually more pronounced as the engine load increases. This condition is not normally felt above 1, 500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or at low speed.

Detonation/Spark Knock

A mild to severe ping which usually occurs worse while under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Dieseling, Run-On

The engine continues to run after the key is turned OFF, but runs very rough.

Engine Control Module (ECM) Commanded Reduced Engine Power

The ECM illuminates the Reduced Engine Power lamp and will limit engine power under potential engine/vehicle damaging or emissions related conditions. A DTC may not be set.

Fuel Odor

A noticeable smell of unburned fuel.

Hard Start

The engine cranks OK, but does not start for a long time. The vehicle does eventually run, or may start but immediately stall.

Hesitation, Sag, Stumble

A momentary lack of response as the accelerator is pushed down. This condition can occur at any vehicle speed. This condition is usually more pronounced when first trying to make the vehicle move, as from a stop. This condition may cause the engine to stall in severe conditions.

Lack of Power, Sluggishness, or Sponginess

The engine delivers less than expected power. Little or no increase in vehicle speed when the accelerator pedal is pushed down part way.

Poor Fuel Economy

Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Rough, Unstable, or Incorrect Idle and Stalling

The engine runs unevenly at idle. If severe, the engine or the vehicle may shake. Engine idle speed may vary. Either condition may be severe enough to stall the engine.

Surges/Chuggles

An engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.

Symptoms Verification

Before using the Symptom tables, perform the following inspections:

- Verify the malfunction indicator lamp (MIL) is operating correctly. Use the scan tool to command the lamp ON and OFF.
- Verify there are no DTCs that are stored.
- Verify the scan tool data is within a normal operating range. Refer to [Control Module References](#) for scan tool information.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movements of a component. Refer to the following for a list of issues that may cause an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Incomplete connector mating
- Poor terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness that is too short or tight
- Wire insulation that is chaffed or cut
- High or low ambient temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surfaces
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of aftermarket, add on accessories

Visual/Physical Check

- Verify the control module grounds are clean, tight, and correctly located.
- Verify the vacuum hoses are not split or kinked, and are properly connected.
- Verify the air filter is clean and free from restrictions.

- Verify there is no water intrusion in connectors terminals and components.
- Inspect the air intake ducts for the conditions listed below:
 - Collapsed
 - Damaged areas
 - Looseness
 - Incorrect installation
 - Leaking

If any condition listed above has allowed non-metered air to enter the air induction system, the **Throttle Body Idle Air Flow Compensation Reset** procedure must be performed after the repair is complete.

- Inspect for air leaks at the throttle body mounting area, the mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
 - Poor connections
 - Pinches
 - Cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect the terminals for corrosion and correct contact.

Symptoms Testing

Backfire, Cuts Out/Misses, Detonation/Spark Knock, Dieseling/Run-On, Engine Control Module (ECM) Commanded Reduced Engine Power, Hard Start, Hesitation/Sag/Stumble, Lack of Power/Sluggishness/Sponginess, Poor Fuel Economy, Rough, Unstable, or Incorrect Idle and Stalling, or Surges/Chuggles

- Test/inspect the fuel system for the conditions listed below:
 - Incorrect system operation or fuel pressure - Refer to **Fuel System Diagnosis**.
 - Leaking or incorrectly operating fuel injectors - Refer to **Fuel Injector Diagnosis**.
 - Contaminated or poor quality fuel - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis**.
- Test/inspect the ignition system for the conditions listed below:
 - Spark plugs with incorrect heat range or an abnormal condition - Refer to **Spark Plug Inspection**, and **Ignition System Specifications**.
 - Coolant or oil fouled spark plugs - For diagnosis, refer to **Coolant in Combustion Chamber**, or **Oil Consumption Diagnosis**.
 - Secondary ignition system susceptible to moisture. Engine running, wet down the secondary ignition system with water from a spray bottle to help locate damaged or deteriorated components. Look/listen for arcing or misfiring as the water is applied.
 - Weak spark using the J-26792 Spark Tester - Refer to **Electronic Ignition System Diagnosis**.
- Test/inspect for the conditions listed below:
 - Non-metered air flow into the air induction system. If a leak is found, repair as necessary. The **Throttle Body Idle Air Flow Compensation Reset** procedure must be performed when the repair is complete.
 - Incorrectly operating transmission torque converter clutch (TCC) - The scan tool should indicate an engine speed drop when the TCC is commanded ON. Refer to **Torque Converter Diagnosis (LTG)**.
 - Incorrectly operating A/C compressor.
 - An engine that runs lean or rich. Observe the Fuel Trim parameters with a scan tool - Refer to **DTC P0171 or P0172** for more information.
 - Slow responding heated oxygen sensors (HO2S) - The HO2S should respond quickly to different throttle positions - Refer to **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271** for more information.

CAUTION: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) .

- Water intrusion in the HO2S connector

NOTE: The embossed arrows on the mass air flow (MAF) sensor indicate the direction of the intake air flow. The arrows must point toward the engine.

- Incorrect mass air flow sensor installation. A mass air flow sensor that is incorrectly installed may cause a hard start. Install the mass air flow in the proper direction. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) .
- Incorrect mass air flow sensor connections.
- Engine oil contaminated by fuel
- Split or kinked vacuum hoses - Verify that the routing and connections are correct.
- Excessive knock sensor system spark retard activity - Observe the Knock Retard parameter on the scan tool for activity more than 0°.
- Electromagnetic interference (EMI) on the reference circuit, which can cause a misfire condition. You can usually detect electromagnetic interference with a scan tool by monitoring the engine speed parameter. A sudden increase in the engine speed parameter with little change in actual engine speed indicates that electromagnetic interference is present. Inspect the high voltage components near the ignition control circuit if a condition exists.
- A crankshaft position sensor with an intermittent condition - Observe the scan tool Crankshaft Position Resync Counter parameter. The Resync Counter parameter should remain at 0 during all operating conditions, and when moving the related harnesses and connectors between the crankshaft position sensor and the ECM.
- A stuck open evaporative emission (EVAP) canister purge solenoid.
- Incorrectly operating crankcase ventilation valve - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Test/inspect the engine cooling system for the conditions listed below:
 - A thermostat with incorrect heat range. Refer to [Thermostat Diagnosis](#) .
 - Incorrect engine coolant level - If the level is low, refer to [Loss of Coolant](#) .

For additional information, refer to [Symptoms - Engine Cooling](#) .

- Test/inspect the exhaust system components for the conditions listed below:
 - Physical damage or possible internal failure
 - Restricted three-way catalytic converters

For additional information, refer to [Symptoms - Engine Exhaust](#) .

- Test/inspect the engine for the mechanical conditions listed below:
 - Excessive oil in the combustion chamber or leaking valve seals
 - Oil consumption
 - Incorrect cylinder compression
 - Sticking or leaking valves
 - Worn camshaft lobes
 - Incorrect valve timing
 - Worn rocker arms
 - Broken valve springs
 - Excessive carbon buildup in the combustion chambers - Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
 - Incorrect engine parts

For additional information, refer to [Symptoms - Engine Mechanical](#) .

- If the above conditions do not address the symptom, refer to the Additional Symptoms Tests.

Additional Symptoms Tests

Detonation/Spark Knock

- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to that parameter listed on the [K20 Engine Control Module: Scan Tool Information](#) , list. If the reading is not in the range specified in the list, test the resistance of the ECT sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#) , for resistance specifications. Replace the ECT sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#) . If the sensor is within the specification, test the ECT sensor circuits for high resistance.
- Test for an engine overheating condition. Refer to [Engine Overheating](#) .
- Inspect for excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicle minimum octane requirements.

ECM Commanded Reduced Engine Power

Under certain conditions the engine control module may limit engine power by reducing engine torque and, for some vehicles, fuel pressure as well. For most, but not all of the conditions, the engine control module will illuminate the reduced engine power lamp on the instrument cluster. If equipped with the driver information center feature, a reduced engine power message may be displayed as well. A DTC may not be set.

A repair may not be necessary. Observe the scan tool Reduced Engine Power History parameter or refer to [K20 Engine Control Module: Scan Tool Information](#) to determine the reason for the reduced engine power event.

Verify or inspect for the following:

- Vehicle being operated at sustained high engine speeds, or, towing heavy loads up an incline for an extended period of time, which may cause the engine oil or coolant to overheat. Inspect the airflow passageways in front of the engine for obstructions and clear away any debris or foreign material that is found. If no obstructions are found, review approved driving habits with the customer. The customer may need to operate the vehicle at a higher engine speed to improve cooling system performance, or, at a slower engine speed to reduce engine load.
- A cooling fan condition which may cause the engine control module to reduce engine power. Refer to [Cooling Fan Description and Operation](#) , and [Cooling System Description and Operation](#) to verify correct operation of the cooling fan.
- Temporarily reduced engine power. Under extremely cold ambient temperatures some SIDI equipped vehicles may experience ECM commanded reduced engine power for a few minutes during engine warm-up. This would be a normal condition, noticeable only at wide open throttle, and the reduced engine power lamp would not be illuminated.
- Reduced engine power due to OnStar® remote command. Verify the vehicle is not in the OnStar® initiated Stolen Vehicle Slowdown mode. Refer to [OnStar Stolen Vehicle Slowdown Active](#) , and [Remote Vehicle Speed Limiting Description and Operation](#) for additional information.
- Turbocharger boost pressure out of range, if equipped. Refer to [DTC P0234 or P0299](#) .
- High pressure fuel system condition. Refer to [Fuel System Diagnosis](#), and [Fuel System Description](#) to verify high pressure fuel system operation.
- Intake air temperature out of range too high. Observe the scan tool IAT Sensor 1 and IAT Sensor 2 parameters. The readings should be within 9Â°C (16Â°F) of each other.
- Fuel temperature out of range too high. Observe the scan tool Fuel Temperature Sensor parameter.
- If equipped with automatic transmission, an incorrect learned brake pedal position (BPP) sensor. Verify the following actions have not occurred:
 - An engine control module has been replaced

- The BPP sensor has been replaced
- The BPP sensor is misaligned or incorrectly installed.

If any of the above actions have occurred, the [Brake Pedal Position Sensor Calibration](#) procedure must be performed.

Fuel Odor

- Inspect for leaking, damaged, or deteriorated fuel lines.
- Inspect for a saturated EVAP canister - Refer to [Evaporative Emission Control System Description](#).
- Inspect for a condition with the internal components of the fuel tank assembly - Refer to [Fuel System Description](#).

Hard Start

- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and clean, if necessary. Refer to [Throttle Body Cleaning](#).
- Test the engine coolant temperature (ECT) sensor. Compare the ECT sensor value to the intake air temperature (IAT) sensor value on a cold engine. The ECT and IAT sensor values should be within $\pm 3^{\circ}\text{C}$ (5°F). If the engine coolant temperature sensor is out of range with the intake air temperature sensor, test the resistance of the engine coolant temperature sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#), for resistance specifications. Replace the engine coolant temperature sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#). If the sensor is within the specification, test the engine coolant temperature sensor circuits for high resistance.
- Verify that the fuel system has adequate pressure for engine start-up. The fuel pump control module should command the fuel pump ON for 2 s when the ignition is turned ON. Refer to [Fuel System Description](#), and [Fuel System Diagnosis](#).
- Inspect for excessive crankshaft endplay that will cause the crankshaft position sensor reluctor wheel to move out of alignment with the crankshaft position sensor. Refer to [Crankshaft and Bearing Cleaning and Inspection](#), and [Engine Mechanical Specifications](#).

Hesitation, Sag, Stumble

- Test the fuel pressure. Refer to [Fuel System Diagnosis](#).
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).
- Test the generator. Refer to [Symptoms - Engine Electrical](#). Repair the charging system if the generator output voltage is less than 9 V or more than 16 V.
- Test the manifold absolute pressure (MAP) sensor. Refer to [DTC P0106](#).
- Inspect for excessive crankshaft endplay that will cause the crankshaft position sensor reluctor wheel to move out of alignment with the crankshaft position sensor. Refer to [Crankshaft and Bearing Cleaning and Inspection](#), and [Engine Mechanical Specifications](#).

NOTE: The following actions may need to be repeated in order to verify an intermittent intake or exhaust camshaft actuator condition.

- Engine warm and idling, verify the correct operation of the camshaft actuator system. Command the intake and exhaust camshaft actuators from 0 degrees to 20 degrees and back to zero while observing the scan tool Intake Camshaft Position Variance and Exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
 - If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to [Camshaft Position Actuator Exhaust Solenoid Valve Replacement](#), [Camshaft Position Actuator Intake Solenoid Valve Replacement](#), and [Camshaft Actuator System Description](#).

Lack of Power, Sluggishness, or Sponginess (LCV)

- Inspect the engine electrical system for incorrect operation. Refer to [Symptoms - Engine Electrical](#).
- Verify that each injector harness is connected to the correct injector.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).

NOTE: The following actions may need to be repeated in order to verify an intermittent intake or exhaust camshaft actuator condition.

- Engine warm and idling, verify the correct operation of the camshaft actuator system. Command the intake and exhaust camshaft actuators from 0 degrees to 20 degrees and back to zero while observing the scan tool Intake Camshaft Position Variance and Exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
 - If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to [Camshaft Position Actuator Exhaust Solenoid Valve Replacement](#), [Camshaft Position Actuator Intake Solenoid Valve Replacement](#), and [Camshaft Actuator System Description](#).

Lack of Power, Sluggishness, or Sponginess (LTG)

- Inspect the engine electrical system for incorrect operation. Refer to [Symptoms - Engine Electrical](#).
- Verify that each injector harness is connected to the correct injector.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).

NOTE: The following actions may need to be repeated in order to verify an intermittent intake or exhaust camshaft actuator condition.

- Engine warm and idling, verify the correct operation of the camshaft actuator system. Command the intake and exhaust camshaft actuators from 0 degrees to 20 degrees and back to zero while observing the scan tool Intake Camshaft Position Variance and Exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
 - If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to [Camshaft Position Actuator Exhaust Solenoid Valve Replacement](#), [Camshaft Position Actuator Intake Solenoid Valve Replacement](#), and [Camshaft Actuator System Description](#).
- Verify the correct operation of the turbocharger system. Perform the following:
 - Inspect the turbocharger moving components for looseness, binding, wear and damage.
 - Verify that the turbocharger air inlet ducts and outlet ducts are tightly sealed and that the air passages are not obstructed. Engine running, use a solution of dish soap and water in a spray bottle to pinpoint any air leaks.
 - Inspect the turbocharger system for external fluid leaks. Inspect the gaskets and sealing surfaces and look for cracks in the turbocharger components. Refer to [Turbocharger Leaking Fluids Externally](#), and [Turbocharger Smoke or Smell](#).
 - Inspect for excessive turbocharger system noise. Refer to [Turbocharger Noise](#).
 - Inspect for a loss of turbocharger pressure. Refer to [Turbocharger Loss of Boost Pressure](#).
 - For additional information, refer to [Turbocharger System Description](#), and [Camshaft Cover and Compressor Air Intake Turbocharger Cleaning and Inspection](#).

Poor Fuel Economy

- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and clean, if necessary. Refer to [Throttle Body Cleaning](#).
- Inspect for heavy loads being carried or towed
- Inspect for acceleration rate too much or too often
- Inspect for incorrect operation of the speedometer.
- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to that parameter listed on the [K20 Engine Control Module: Scan Tool Information](#), list. If the reading is not in the range specified in the list, test the resistance of the engine coolant temperature sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#), for resistance specifications. Replace the engine coolant temperature sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#). If the sensor is within the specification, test the engine coolant temperature sensor circuits for high resistance.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).
- Inspect the brake system for brake drag.

Rough, Unstable, or Incorrect Idle and Stalling

- An excessively high idle may be due to the floor mat interfering with the accelerator pedal. With this condition present, it may not be possible to shift the transmission into gear. Inspect the accelerator pedal for binding and verify that the floor mat is not interfering with the accelerator pedal movement.
- Engine idle speed may be unstable or the engine may stall if the ECM has learned an incorrect idle/airflow compensation value. A DTC may also set. Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. If the throttle body needs cleaning, refer to [Throttle Body Cleaning](#).

The actions listed below may also cause the ECM to learn an incorrect idle value.

- The engine control module has been replaced
- The throttle body has been replaced
- The throttle body has been cleaned but the idle learn procedure was not performed after completing the cleaning
- The air induction system was leaking, allowing non-metered air to enter the combustion chamber. The leak was repaired but the idle learn procedure was not performed after repairing the leak

If any of the actions listed above have occurred, the [Throttle Body Idle Air Flow Compensation Reset](#) procedure must be performed.

- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).
- Inspect the engine mounts. Refer to [Engine Mount Inspection](#).
- Inspect the intake and exhaust manifolds for casting flash.

Surges/Chuggles

- Verify that each injector harness is connected to the correct injector.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#).
- Inspect for slow responding heated oxygen sensors (HO2S). The HO2S should respond quickly to a change in throttle position. If the HO2S do not respond to different throttle positions, inspect for contamination from fuel, silicon, or the incorrect use of RTV sealant. The sensors may have a white powdery coating and result in a high, but false, signal voltage, which gives a rich exhaust indication. The PCM reduces the amount of fuel delivered to the engine, causing a driveability

condition. Refer to [DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271](#) for more information.

MALFUNCTION INDICATOR LAMP (MIL) DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

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

Diagnostic Aids

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

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Instrument Cluster Wiring Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

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

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

Refer to Circuit/System Testing

- **Go to next step: If Malfunction is not displayed**
3. Engine running.
 4. Verify the parameters listed below do not display Malfunction when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing

 - **Go to next step: If Malfunction is not displayed**
 5. Verify the malfunction indicator lamp turns ON and OFF when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
 - **If the malfunction indicator lamp does not turn ON and OFF**

Refer to Circuit/System Testing

 - **Go to next step: If the malfunction indicator lamp turns ON and OFF**
 6. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the X1 harness connector at the K20 Engine Control Module.
3. Ignition ON, verify the malfunction indicator lamp does not illuminate.
 - **If the malfunction indicator lamp illuminates**
 1. Test for infinite resistance between the control circuit terminal X1 71 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.
 - **Go to next step: If the malfunction indicator lamp does not illuminate**
4. Connect a 3 A fused jumper wire between the control circuit terminal X1 71 and ground.
5. Verify the malfunction indicator lamp illuminates.
 - **If the malfunction indicator lamp illuminates**

Replace the K20 Engine Control Module.

 - **If the malfunction indicator lamp does not illuminate**
 1. Test for less than 1 V between the control circuit terminal X1 71 and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - Go to next step: If less than 1 V
 2. Ignition OFF.
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - Go to next step: If less than 2 Ω .
6. Ignition OFF, disconnect the X1 harness connector at the instrument cluster.
7. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 16 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - **Go to next step: If the test lamp illuminates**
8. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Instrument Cluster Replacement](#)
- [Control Module References](#) for control module replacement, programming, and setup

ENGINE CRANKS BUT DOES NOT RUN

Diagnostic Instructions

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

Circuit/System Description

This Engine Cranks but Does Not Run is an organized approach to identify a condition which causes the engine to crank but not start. This diagnostic directs the technician to the appropriate system diagnosis.

Diagnostic Aids

Inspect for any of the conditions listed below:

- On vehicles equipped with a key type starting system, the key fob must be in the correct position when attempting to start the engine. The mechanical portion of the key must be locked in the fully extended position with the fob parallel to the key. Leaving the key partially retracted or folded over when attempting to start the engine may interrupt transponder authentication and result in an intermittent no-start condition. In such instances, DTC B3055 may also be set. If an intermittent no-start complaint is received, it may be necessary to discuss with the customer their starting habits and verify they are locking the key in the fully extended position, fob parallel to the key, before starting.
- Check the crankshaft position sensor engine reference signal with a scan tool. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200-300 RPM while cranking. If erratic values, such as sudden spikes in the engine speed are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
- The engine control module (ECM) uses the camshaft position sensors to determine engine speed and position when there is a crankshaft position sensor condition. If a crankshaft position sensor condition exists, the engine will operate only if the ECM has stored the learned reference position of the camshafts in ECM memory. With a crankshaft position sensor condition in the signal circuit, the engine will go into a limp home mode after a hard restart. The ECM then calculates engine speed from the camshaft position sensor.
- The chassis control module controls and monitors the operation of the in-tank fuel pump. If the chassis control module detects a fault, a DTC sets in the chassis control module. The chassis control module will then send a serial data message to the engine control module (ECM) requesting the illumination of the malfunction indicator lamp (MIL).
- Insufficient fuel can cause a no start condition. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid, can cause a no start condition. Refer to [Fuel Injector Diagnosis](#).
- There may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the fuel injectors and the injector circuit are OK, and fuel spray is detected, the fuel injector ON time may be inadequate. If the engine control

module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.

- Inspect the engine for good secure electrical grounds.
- Water or foreign material in the fuel can cause a no start or engine will not stay running condition. During freezing weather water can freeze inside the fuel system. The engine may start after 30 min in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.
- An engine that starts and runs after being brought to the repair shop for a no start condition, may have an ignition system that is susceptible to moisture. Spray water on the ignition system components and the wiring in order to check for an engine starting or will not stay running concern.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Starting System Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J 26792 HEI Spark Tester

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

NOTE: This diagnostic assumes the following:

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

1. Crank the engine for up to 15 s.
2. Verify that P0201-P0204, P0230, P0231, P0232, P023F, P025A, P0335, P0336, P0351-P0354, P0601, P0602, P0603, P0604, P0606, P0607, P060E, P062F, P0685, P0689, P0690, P069E, P1516, P1682, P2610, or P2635 is not set.

- If any of the DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- Go to next step: If none of the DTCs are set

3. Ignition ON.

4. Verify the security indicator on the instrument panel cluster illuminates momentarily.

- **If the indicator stays ON or is flashing**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , and [Immobilizer Description and Operation](#)

- **Go to next step: If the indicator does not stay ON and is not flashing**

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

- **If 0 RPM**

Refer to [DTC P0335 or P0336](#) for further diagnosis.

- **Go to next step: If greater than 0 RPM**

6. Ignition OFF.

7. Disconnect the T8 ignition coil from a cylinder and spark plug.

8. Connect a **J 26792** HEI Spark Tester between the boot of the ignition coil and ground.

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

9. Verify that the spark tester sparks while cranking the engine.

- **If the spark tester does not spark**

Refer to [Electronic Ignition System Diagnosis](#) for further diagnosis.

- **Go to next step: If the spark tester sparks**

10. Ignition ON.

NOTE:

- **If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Allow the engine coolant temperature to cool to less than 60Â° C (150Â° F) before attempting to verify fuel pressure.**
- **The Fuel Pump Enable may need to be commanded On a few times in order to obtain the highest possible fuel pressure.**
- **Additional DTCs may set when using the fuel pump output control.**

11. Command the Fuel Pump Enable On several times with a scan tool.

12. Verify that the scan tool Fuel Pressure Sensor parameter is between 345 - 650 kPa (50 - 94 psi) while the fuel pump is running.

- **If not within the specified range**

Refer to [Fuel System Diagnosis](#).

- **Go to next step: If within the specified range**

13. Verify that the scan tool Fuel Pressure Sensor parameter, after the pump has turned OFF, decreases to less than 600 kPa (87 psi), and does not decrease greater than 34 kPa (5 psi) in 1 minute.

- **If not within the specified range**

Refer to [Fuel System Diagnosis](#).

- **Go to next step: If within the specified range**

14. Ignition OFF, disconnect the harness connector of a fuel injector.

15. Connect a test lamp between the control circuit and the ignition voltage circuit of the harness connector.

NOTE: Perform the fuel injector test on at least 3 fuel injectors

16. Verify the test lamp flashes while cranking the engine.

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

Refer to [Fuel Injector Circuit Diagnosis](#).

- **Go to next step: If the test lamp flashes**

17. Verify that the conditions listed below do not exist:

- Collapsed or restricted air intake duct to the throttle body
- Restricted air filter
- Gas or coolant fouled spark plugs
- A skewed manifold absolute pressure (MAP) sensor. Refer to [DTC P0106](#) .
- A skewed engine coolant temperature (ECT) sensor. Refer to [DTC P0117, P0118, or P0119](#) .
- A restricted exhaust system. Refer to [Restricted Exhaust](#) .
- Contaminated fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- An engine mechanical condition, for example, worn timing chain and gears or low compression. Refer to [Symptoms - Engine Mechanical](#) , or [Engine Compression Test](#) .
- **If a condition exists**

Repair as necessary.

- **Go to next step: If no conditions exist**

18. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Spark Plug Replacement

FUEL SYSTEM DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

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

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

The fuel tank stores the fuel supply. An electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank. The fuel pump supplies fuel through the fuel feed pipe and the fuel feed front pipe check valve to the high pressure fuel pump. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel tank fuel pump module. The function of the venturi pump is to fill the fuel tank fuel pump module reservoir. The fuel tank fuel pump module contains a reverse flow check valve. Both check valve maintains fuel pressure in the fuel feed pipe in order to prevent long cranking times.

Diagnostic Aids

- A faulty fuel feed front pipe check valve may cause a rattle, tick, knock, or buzz noise. The noise may be more pronounced at idle, approximately 600-800 RPM.
- An erratic low side fuel pressure reading may be caused by a faulty fuel feed front pipe check valve.
- Observe the Misfire Counters or perform the Fuel Injector Diagnosis to help identify a leaking fuel injector.

Reference Information

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **CH-41769** Fuel Line Quick Disconnect Tool
- **EN-37287** Fuel Line Shut-off Adapter

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

NOTE:

- Repair all fuel system related DTCs, except P2635, before performing this diagnostic.
- Inspect the fuel system for damage or external leaks before proceeding.
- Verify that adequate fuel is in the fuel tank before proceeding.
- The Fuel Pump Enable may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.
- DO NOT perform the Fuel System Diagnosis if the engine coolant temperature is above 60°C (150°F). High fuel pressure readings may result due to hot soak fuel boiling. With the engine OFF, the fuel pressure may increase beyond the pressure relief regulator valve's setting point of 690 kPa (100 PSI) $\pm$ 5%.

1. Ignition ON, engine OFF, command the Fuel Pump Enable On several times with a scan tool.
2. Verify the scan tool Fuel Pressure Sensor parameter is between 345 - 650 kPa (50 - 94 PSI) with the fuel pump running.

- **If less than 345 kPa (50 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 650 kPa (94 PSI)**

Replace the G12 Fuel Pump.

- **Go to next step: If between 345 - 650 kPa (50 - 94 PSI)**

3. Verify that the scan tool Fuel Pressure Sensor parameter, after the fuel pump is turned off, decreases to less than 600 kPa (87 PSI).

- **If greater than 600 kPa (87 PSI)**

Replace the G12 Fuel Pump.

- **Go to next step: If less than 600 kPa (87 PSI)**

4. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease greater than 34 kPa (5 PSI) in 1 min.

- **If greater than 34 kPa (5 PSI)**

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

- **Go to next step: If less than 34 kPa (5 PSI)**

5. Engine idling.

6. Verify the scan tool Fuel Pressure Sensor parameter is between 300 - 400 kPa (43 - 58 PSI).

- **If less than 300 kPa (43 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 400 kPa (58 PSI)**

Replace the G12 Fuel Pump.

- **Go to next step: If between 300 - 400 kPa (43 - 58 PSI)**

7. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **Go to next step: If less than 1.5**

8. Verify the scan tool Pressure Sensor and the Desired Fuel Pressure are within 45 kPa (6.5 PSI) at 300 kPa (43.5 PSI) request or 60 kPa (8.7 PSI) at 400 kPa (58 PSI) request of each other while operating the vehicle through varying loads.

- **If greater than 45 kPa (6.5 PSI)/60 kPa (8.7 PSI)**

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

- **Go to next step: If less than 45 kPa (6.5 PSI)/60 kPa (8.7 PSI)**

9. If the fuel system components test normal, refer to [Symptoms - Engine Controls](#), and [Fuel Injector Diagnosis](#) for further diagnosis.

Circuit/System Testing

Fuel Pressure Low

1. Verify none of the conditions listed below exist:

- Restricted or dislocated fuel feed front pipe check valve
- Restricted fuel feed pipe
- Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
- **If a condition exists**

Repair as necessary.

- **Go to next step: If no conditions exist**

2. Replace the K20 Engine Control Module.

Fuel Pressure Leaks Down

1. Ignition OFF, relieve the fuel pressure. Refer to [Fuel Pressure Relief](#).
2. Install the **EN-37287** between the chassis fuel feed hose and the high pressure fuel pump.
3. Open the valve on the **EN-37287**.
4. Ignition ON, command the Fuel Pump Enable On and then Off with a scan tool.
5. Close the valve on the **EN-37287**.
6. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease greater than 34 kPa (5 PSI) in 1 min.
 - **If greater than 34 kPa (5 PSI)**

Replace the G12 Fuel Pump.
 - **Go to next step: If less than 34 kPa (5 PSI)**
7. Test for a faulty fuel feed front pipe check valve.
 - **If a condition exists**

Replace the fuel feed front pipe.
 - **Go to next step: If no condition exists**
8. Test for a leaking G18 High Pressure Fuel Pump.
 - **If a condition exists**

Replace the G18 High Pressure Fuel Pump.
 - **Go to next step: If no condition exists**
9. Locate and replace the leaking Q17 Fuel Injector.

Fuel Pressure Drops Off

1. Verify none of the conditions listed below exist:
 - Restricted or dislocated fuel feed front pipe check valve
 - Restricted fuel feed pipe
 - Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
 - **If a condition exists**

Repair as necessary.
 - **Go to next step: If no conditions exist**
2. Replace the G12 Fuel Pump.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Fuel Feed Pipe Replacement](#)
- [Fuel Pump Replacement](#) for G18 High Pressure Fuel Pump replacement
- [Fuel Injector Replacement](#)
- [Fuel Tank Fuel Pump Module Replacement](#)

FUEL LEAK DIAGNOSIS

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Aids

Fluorescent dye assists in locating leaks in the system. A high-intensity black light will make the dye glow. - Green or Yellow

Illuminate the area(s) of concern. For example:

- G18 High Pressure Fuel Pump
- Q17 Fuel Injector
- Fuel Line
- Fuel Rail
- {If equipped} Fuel Return Pipe

Reference Information

Special Tools

- J-28428-E High-Intensity Black Light Kit
- J-42220 Universal 12 V Leak Detection Lamp

Circuit/System Verification

1. Perform the following action: Clean all of the components in the suspected area using a cleaning solution and allow the components to dry: Fuel System
2. Perform the following action: Add 237 mL (8 US fl oz) of GM Approved Oil Dye to the component: Fuel Tank - Primary
3. Engine - Idling - For 3 to 5 min
4. Perform the scan tool control function: Fuel Pressure Control - Regulator 1 - Increase - Maximum Pressure - If applicable

CAUTION: When performing a Fuel Leak Diagnosis, it is VERY IMPORTANT to use only GM approved Oil Dye, Part Number 88861206. If any other oil dye is used, it will cause damage to the fuel injection system components, as well as the emission control components. This will result in necessary replacement of the damaged components.

5. Use the special tool: J-28428-E High-Intensity Black Light Kit or J-42220 Universal 12 V Leak Detection Lamp - Illuminate the area(s) of concern.

Verify there are no leaks in the component/system: High Pressure Side of the Fuel System or Return Side of the Fuel System

- {High Pressure Side of the Fuel System} If a leak is present

Repair or replace as necessary.

- {Return Side of the Fuel System} If a leak is present

Refer to: [Diagnostic Procedure Instructions](#)

- Go to next step: If no leak is present

6. All OK.

FUEL INJECTOR DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

The engine control module (ECM) supplies a separate high voltage supply circuit and a high voltage control circuit for each fuel injector. The injector high voltage supply circuit and the high voltage control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit. The ECM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through the injector high voltage supply circuit, allowing for initial injector opening. The injector is then held open with 12 V. A fuel injector coil winding resistance that is too high or too low will affect the engine driveability. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

Two methods of testing fuel injector balance are available, the Active Fuel Injector Tester (AFIT) or a scan tool. The Active Fuel Injector Tester and SIDI adaptor connects to the engine control module harness connectors to test the high pressure fuel pump performance, fuel injector wiring, and fuel injector operation. The AFIT displays step by step instructions to precisely determine pressure drop of each fuel injector. The scan tool fuel injector balance test is performed while the engine is running at idle. The scan tool pressurizes the fuel rail to a predetermined pressure before each fuel injector is pulsed for a precise amount of time allowing a measured amount of the fuel to be injected. This causes a drop in the system fuel pressure that is recorded and used to compare each fuel injector.

Diagnostic Aids

- Monitoring the scan tool Cylinder 1-4 Current Misfire Counters may help to isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Special Tools

- **CH-47976** Active Fuel Injector Tester
- **CH-47976-500** Active Fuel Injection Tester (AFIT) SIDI Adapter Kit

For equivalent regional tools, refer to [Special Tools](#)

Fuel Injector Coil Test

NOTE:

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

1. Remove the intake manifold and disconnect the appropriate Q17 Fuel Injector.
2. Test for 1.35 - 1.65 Ω at 20 $^{\circ}$ C (68 $^{\circ}$ F) between the high voltage supply circuit terminal 2 and the high voltage control circuit terminal 1 at the Q17 Fuel Injector.
 - **If not between 1.35 - 1.65 Ω**

Replace the Q17 Fuel Injector.

- **Go to next step: If between 1.35 - 1.65 Ω**

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

- **If less than infinite resistance**

Replace the Q17 Fuel Injector.

- **Go to next step: If infinite resistance**

4. All OK. Perform the Fuel Injector Balance Test.

Fuel Injector Balance Test

NOTE:

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

Fuel Injector Balance Test with Active Fuel Injector Tester - Preferred Method

1. Verify the battery is fully charged and all accessories are OFF.
2. Ignition OFF, all vehicle systems OFF. Install the **CH-47976** Active Fuel Injector Tester and the **CH-47976-500** Active Fuel Injection Tester (AFIT) SIDI Adapter Kit, refer to the Active Fuel Injector Tester User Guide. It may take up to 2 min for all vehicle systems to power down.
3. Turn ON the Active Fuel Injector Tester and select the vehicle.
4. Ignition ON, perform the Injector Test with the Active Fuel Injector Tester.
 - **If the Active Fuel Injector Tester aborts testing due to incorrect fuel pressure or fuel leak down**

Refer to [Fuel System Diagnosis](#).

- **Go to next step: If the Active Fuel Injector Tester does not abort testing**

5. Compare the test results with the appropriate recommended tolerance.

- **If any fuel injector exceeds the recommended tolerance**

Replace the appropriate Q17 Fuel Injector(s).

- **Go to next step: If all fuel injectors are within the recommended tolerance**

6. Perform the [Fuel Injector Circuit Diagnosis](#).

Fuel Injector Balance Test with Scan Tool

1. Verify the correct low side fuel pressure. Refer to [Fuel System Diagnosis](#).
2. Engine idling, verify the scan tool Fuel Rail Pressure Sensor parameter is approximately 3 MPa (435 psi).

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

3. Select the Fuel Injector Balance function within the Control Functions menu of a scan tool.
4. Select and test an injector. Repeat for each injector.
5. Obtain and record a pressure drop value for each injector.
6. Add all of the individual pressure drop values except for the injector suspected of being faulty. This is the total pressure drop.

7. Divide the total pressure drop by the number of fuel injectors that were added together. This is the average pressure drop.
8. Multiply the average pressure drop by 0.20. This is the acceptable variance from the average pressure drop, 20 percent.
9. Verify the difference between any individual pressure drop and the average pressure drop is not greater than the acceptable variance.

- **If greater than the acceptable variance**

Replace the Q17 Fuel Injector.

- **Go to next step: If within the acceptable variance**

10. Perform the **Fuel Injector Circuit Diagnosis**.

Repair Instructions

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

Fuel Injector Replacement

FUEL INJECTOR CIRCUIT DIAGNOSIS

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Injector 1 Control +	P2147	P0201	P2148	P1248
Fuel Injector 1 Control -	P0261	P0201	P2148	P1248
Fuel Injector 2 Control +	P2150	P0202	P2151	P1249
Fuel Injector 2 Control -	P0264	P0202	P2151	P1249
Fuel Injector 3 Control +	P2153	P0203	P2154	P124A
Fuel Injector 3 Control -	P0267	P0203	P2154	P124A
Fuel Injector 4 Control +	P2156	P0204	P2157	P124B
Fuel Injector 4 Control -	P0270	P0204	P2157	P124B

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the injector high voltage supply circuits and the injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Diagnostic Aids

- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to **Fuel Injector Diagnosis**.
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Powertrain Component View

[Powertrain Component Views](#)

Description and Operation

[Fuel System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

NOTE: **Do Not perform this procedure unless directed here from the Fuel Injector Balance Test.**

1. Engine idling.
2. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter parameters do not increment.
 - **If the Cylinder 1 - 4 Current Misfire Counters increment**
Refer to Circuit/System Testing.
 - **Go to next step: If the Cylinder 1 - 4 Current Misfire Counters do not increment**
3. Verify the scan tool Cylinder 1 - 4 Injector Control Circuit Status parameters display OK.
 - **If the Cylinder 1 - 4 Injector Control Circuit Status parameters do not display OK**
Refer to Circuit/System Testing.
 - **Go to next step: If the Cylinder 1 - 4 Injector Control Circuit Status parameters display OK**
4. All OK.

[Circuit/System Testing](#)

1. Ignition OFF, all vehicle systems OFF, disconnect the harness connector at the K20 Engine Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for infinite resistance between the appropriate Q17 Fuel Injector control + circuit and ground.
 - **If less than infinite resistance**
 1. Disconnect the harness connector of the Q17 Fuel Injector.
 2. Test for infinite resistance between the Q17 Fuel Injector control + circuit and ground.
 - If less than infinite, repair the short to ground in the circuit.
 - Go to next step: If infinite resistance
 3. Test for infinite resistance between the Q17 Fuel Injector control - circuit and ground.
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite, replace the Q17 Fuel Injector.

- **Go to next step: If infinite resistance**

3. Ignition ON.

4. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.

- **If 1 V or greater**

1. Disconnect the harness connector of the Q17 Fuel Injector, ignition ON.

2. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, repair the short to voltage on the control - circuit.

- **Go to next step: If less than 1 V**

5. Ignition OFF.

6. Test for less than 3 Ω between the Q17 Fuel Injector control + circuit and control - circuit.

- **If 3 Ω or greater**

1. Disconnect the harness connector of the Q17 Fuel Injector.

2. Test for less than 2 Ω on the control + circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- Go to next step: If less than 2 Ω

3. Test for less than 2 Ω on the control - circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the Q17 Fuel Injector.

- **Go to next step: If less than 3 Ω**

7. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic repair.

- [Control Module References](#) for ECM replacement, programming and setup,
- [Fuel Injector Replacement](#)

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

Diagnostic Instructions

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

Test Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

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

Reference Information

Special Tool

CH 44175-A Fuel Composition Tester, if available

For equivalent regional tools, refer to [Special Tools](#).

System Verification

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear.

- If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample, perform the Particulate Contaminants in Fuel Testing Procedure.
- If alcohol contamination is suspected, perform the Alcohol in Fuel Testing procedure.

Alcohol in Fuel Testing with Special Tool, If Available

1. Test the fuel composition using the **CH 44175-A** Fuel Composition Tester and the Instruction Manual.
2. If water appears in the fuel sample, clean the fuel system.
3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
4. If the fuel sample contains more than 15 percent ethanol, add fresh, regular gasoline to the vehicle's fuel tank.
5. Test the fuel composition.
6. If testing shows the ethanol percentage is still more than 15 percent, replace the fuel in the vehicle.

Alcohol in Fuel Testing without Special Tool

1. Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
2. Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.
3. Shake the cylinder vigorously for 10 - 15 seconds.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10 - 15 seconds.
6. Put the cylinder on a level surface for approximately 5 min in order to allow adequate liquid separation. If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

Particulate Contaminants in Fuel Testing Procedure

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

Repair Instructions

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

- **Fuel System Cleaning**
- **Fuel Tank Draining**

EVAPORATIVE EMISSION SYSTEM DIAGNOSIS

Special Tools

- **CH-44284-2** Fuel Flapper Door Holder
- **EN-41413-VLV** EVAP Service Port Vent Fitting

- **GE-41415-60** Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

Operating Instructions for the Evaporative Emission System Tester

Vehicle Setup

WARNING: Refer to Fuel and Evaporative Emission Pipe Warning .

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

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

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

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

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

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

Flow Meter Test - Leak Detection

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

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

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

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

NOTE:

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

and force any smoke to pass through the on-board refueling vapor recovery pipe and orifice.

7. Press and release the remote switch to activate the nitrogen flow and fill the system.
8. Verify the stable floating indicator position to the red flag.
 - **Above the red flag, result is unacceptable - fail**

Go to the Smoke Procedure

- **Go to next step: Below the red flag - pass. Test complete**
9. Press and release the remote switch to deactivate the tester.

Smoke Procedure - Locate the Leak

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

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

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

2. Connect the nitrogen/smoke hose to the vehicle as directed in the service procedures. Some vehicles require that the nitrogen/smoke hose be connected at the front of the EVAP system at the EVAP service port. An adapter may be necessary. Other vehicles require the connection be made at the rear of the system using an adapter at the fuel fill cap or capless fuel fill. Consult the service procedures for DTCs that relate to EVAP system leaks for vehicle specific instructions regarding connection location and adapters.
3. Open the Nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to smoke.

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

4. Press and release the remote switch to activate the tester and inject smoke into the EVAP system.
5. Verify smoke has filled the EVAP system by opening the system opposite the end where smoke is injected.

NOTE:

- **When injecting smoke at the service port:**
 - **Vehicles with gas cap - remove fill cap**
 - **Vehicles with capless fuel fill - open flappers with CH-44284-2 or GE-41415-60**

Until smoke is observed, then close the system and continue testing.

- **If using a special tool fuel fill cap/capless fuel fill adapter at the filler neck, vent the system at the service port, with special tool EN-41413-VLV until smoke is observed then remove the vent fitting tool and close the system to continue with the test.**
- **Inject smoke in less than 2 min cycles for optimum tester performance.**

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

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

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

Repair or replace the affected component.
 - **Go to next step: No smoke seen leaking**
9. All OK

Temperature Variation Instructions

The Concern

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

For Example

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

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

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

The Solution

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

ELECTRONIC IGNITION SYSTEM DIAGNOSIS

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

For an overview of the component/system, refer to: [Electronic Ignition System Description](#)

The ECM controls the spark event for each cylinder through individual ignition coil control circuits. When the ECM commands the ignition control circuit On, electrical current flows through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM commands the ignition control circuit Off, interrupting current flow through the primary winding. The collapsing magnetic field created by the primary winding induces a high voltage in the secondary winding, which is connected to the spark plugs. The ignition system on this engine uses ignition coils with integrated power transistors.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Special Tools

J-26792 Ignition Spark Tester

Equivalent regional tools: Special Tools

Circuit/System Testing

NOTE: Do NOT perform this procedure unless directed here from the following diagnostic:

- DTC P0300-P0304
- Engine Cranks But Does Not Run

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: T8 Ignition Coil
3. Test for less than 10 ohms between the test points: Ground circuit terminal 1/A & Ground
 - **If 10 ohms or greater**
 1. Disconnect the ground connection: Ground terminal
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 1/A @ Component harness & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **Go to next step: If less than 10 ohms**
4. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2/B & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2/B @ Component harness & The other end of the circuit

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
5. Ignition - On/Vehicle - In Service Mode
 6. Verify a test lamp turns On between the test points: Ignition circuit terminal 4/D & Ground
 - **If the test lamp does not turn On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 4/D @ Component harness & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **Go to next step: If the test lamp turns On**
 7. Test or replace the component: T8 Ignition Coil

Component Testing

With Special Tool

NOTE: Circuit/System Testing must be performed before proceeding with Component Testing.

1. Ignition/Vehicle - Off
2. Remove the appropriate component: T8 Ignition Coil - Leave the electrical connector connected.
3. Install the special tool: J-26792 Ignition Spark Tester
4. Engine - Running

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

5. Verify there is spark at the tool.
 - **If there is no spark**

Test or replace the component: T8 Ignition Coil
 - **Go to next step: If there is spark**
6. All OK.

Without Special Tool

1. Ignition/Vehicle - Off
2. Swap the two components: T8 Ignition Coil - The original component that set the DTC & Another known good component from the vehicle
3. Engine - Running
4. Verify the scan tool parameter: Cylinder 1 - 4 Current Misfire Counter = Increments - At the original component location the DTC set.
 - **If the parameter value does not increment**

Replace the component: T8 Ignition Coil - The original component that set the DTC
 - **Go to next step: If the parameter value increments**
5. Refer to: Circuit/System Testing

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Ignition Coil Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

INSPECTION/MAINTENANCE SYSTEM CHECK

Diagnostic Instructions

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

Description

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

While testing in the I/M System Status mode, some DTCs may occur that are called I/M Test DTCs. An I/M Test DTC is defined as a fault code that is currently commanding the malfunction indicator lamp (MIL) ON, and is stored in non-volatile memory. The intended use of this data is to prevent vehicles from passing I/M inspection without proper repair to the vehicle. These fault codes are not erasable from any scan tool command or by disconnecting power to the controller. I/M Test DTCs are supported by all emissions related electronic control units (ECUs), such as engine control modules (ECMs), transmission control modules (TCMs), fuel pump control modules (FPCMs), etc. An I/M Test DTC will not be stored or erased from the ECU except at the end of trip processing which occurs 5 s after ignition OFF.

Conditions for Updating the I/M System Status

NOTE: **New vehicles may not report an Inspection/Maintenance System Check pass or fail status for certain post catalyst oxygen sensor or heated oxygen sensor 2 diagnostics prior to 700 miles. After replacing a catalytic converter on a vehicle with greater than 700 miles, it may require up to an additional 700 miles to prevent a false failure status.**

Each system requires at least one, and sometimes several, diagnostic tests. The results of these tests are reported by a DTC. A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or any one of the DTCs comprising the monitor have illuminated the MIL. Once all of the tests are completed, the Inspection/Maintenance System Status or Data will indicate YES in the Completed or Value column.

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

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

Conditions for Clearing I/M Test DTCs

1. Only the OBD II System can erase I/M Test DTCs. The OBD II system must determine that the malfunction that caused the I/M Test DTC to be stored is no longer present and is not commanding the MIL. Each of the following represents ways to clear an I/M Test DTC:
 - If the MIL goes off due to 3 passing drive cycles, and the scan tool code clear is not used, the I/M Test DTC is erased at power down of the last drive cycle.

- If a scan tool code clear is used to turn OFF the MIL, the I/M Test DTC is not erased, therefore the DTC must PASS and not FAIL during the drive cycle. The I/M Test DTC is erased at power down of the drive cycle.
 - If the controller is reflashed/reprogrammed, all I/M Test DTCs are erased.
2. For the OBD II System to run a single drive cycle for clearing an I/M Test DTC, all of the following conditions must occur:
 - Cumulative time of engine run time greater than 600 s.
 - Cumulative vehicle operation above 40 km/h (25 mph) over 300 s.
 - Continuous vehicle idle greater than 30 s.
 - Ignition OFF for 5 s to allow the code to clear.

Monitored Emission Control Systems

The OBD II system monitors all emission control systems that are on-board, but not all vehicles need every possible emission control system. For example, a vehicle may not be equipped with secondary air injection (AIR) or exhaust gas recirculation (EGR). The OBD II regulations require monitoring of the following; if equipped:

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

For the specific DTCs required for each system, refer to [Inspection/Maintenance \(I/M\) System DTC Table](#). Systems such as misfire and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

Diagnostic Aids

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

The Inspection/Maintenance System Status or Data information may be useful for a technician to determine if diagnostics have run when verifying repairs.

Circuit/System Verification

Review the Inspection/Maintenance System Status or Data indicators. All Inspection/Maintenance System Status or Data indicators should report YES, and no I/M Test DTCs should be present.

Circuit/System Testing

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

1. Observe the Engine DTC information with a scan tool. Verify no DTCs are present.

- If a DTC is set that would prevent the I/M System Status tests from completing, diagnose that DTC before continuing. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
 - If a control module re-program or other repair is required, perform the [Inspection/Maintenance Complete System Set Procedure](#).
 3. Observe the Inspection/Maintenance System Status or Data indicators.
 - If any Inspection/Maintenance System Status or Data indicators report NO, perform the [Inspection/Maintenance Complete System Set Procedure](#).
 4. Observe the I/M Test DTC information with a scan tool. Verify there are no I/M Test DTCs present.
 - If an I/M Test DTC is set and all of the Inspection/Maintenance System Status or Data indicators are Yes, there is no need to perform the Complete System Set Procedure. Diagnose the DTC using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and refer to Conditions for Clearing the I/M Test DTCs.
 - If an I/M Test DTC is set and the Inspection/Maintenance System Status or Data indicators are NO, diagnosis the DTC and perform the [Inspection/Maintenance Complete System Set Procedure](#).

INSPECTION/MAINTENANCE COMPLETE SYSTEM SET PROCEDURE

Diagnostic Instructions

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

Description

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

Conditions for Meeting a Cold Start

- The ignition voltage between 11 - 18 V.
- The barometric pressure is more than 75 kPa (10.9 psi).
- The start-up engine coolant temperature (ECT) is between 4 - 30°C (39 - 86°F).
- The start-up intake air temperature (IAT) is between 4 - 30°C (39 - 86°F).
- The difference between the IAT and the ECT is less than or equal to 6°C (43°F).
- The ambient air temperature is between 4 - 30°C (39 - 86°F).
- The fuel level is between 15 - 85%.

Circuit/System Verification

1. Verify that all I/M System Status indicators report YES, and that no I/M Test DTCs are present.
 - **If any I/M Test DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **Go to next step: If no I/M Test DTCs are set**
2. All OK.

Inspection/Maintenance System Set Procedure

NOTE: Whenever the ignition is turned ON, ignition positive voltage is supplied to the heated oxygen sensor (HO2S) heaters. After

verifying the enable criteria, turn OFF the ignition for approximately 5 min to allow the sensors to cool before continuing with the test. When the engine is started, DO NOT turn the engine OFF for the remaining portion of the set procedure.

1. Ensure that the vehicle meets the conditions for a cold start listed above.
2. The evaporative emission inspection/maintenance system status indicator should display YES.
 - If the inspection/maintenance system status indicator displays NO, perform the Service Bay Test, if applicable. If the Service Bay Test is NOT available, it may take up to 6 drive cycles, with up to 17 h between drive cycles, for the inspection/maintenance system status indicator to transition to YES.
3. The O2S Heater inspection/maintenance system status indicator should display YES.
 - If the O2S Heater inspection/maintenance system status indicator displays NO, ensure that the ignition has been turned OFF for at least 10 h.
4. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc.
5. Set the vehicle parking brake and ensure the vehicle is in Park for automatic transmission or Neutral for manual transmission.
6. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc.
7. Start and idle the engine for at least 2 min and until 65°C (149°F) is achieved.
8. Run the engine for 6.5 min within the following conditions:
 - MAF parameter between 4 - 30 g/s
 - Engine speed steady between 1,000 - 3,000 RPM
9. Return the engine to idle for 1 minute.
10. Apply and hold the brake pedal, and shift to Drive for automatic transmission, or apply the clutch pedal for manual transmission and operate the vehicle within the following conditions for 2 min:
 - Depress the accelerator pedal until throttle position sensor angle is more than 2%.
 - Mass air flow signal between 15 - 30 g/s
 - RPM steady between 1,200 - 2,000 RPM

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

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

WARNING: Refer to [Road Test Warning](#) .

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

NOTE: **DO NOT disturb the vehicle or turn ON the ignition until told to do**

so. Disturbing the vehicle may invalidate this portion of the test.

20. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 60 min.
21. Observe the Inspection/Maintenance System Status with a scan tool. All of the Inspection/Maintenance System Status indicators should display YES.
 - If the evaporative emission Inspection/Maintenance System Status indicator displays NO, turn OFF the ignition for 17 h, ensure that the vehicle meets the conditions for a cold start, and repeat steps 12 - 18 six more times, or until the evaporative emission Inspection/Maintenance System Status indicator transitions to YES. If the indicator continues to display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) to identify the DTCs that did not run. Follow the Conditions for Running the DTC in order to set the evaporative emission Inspection/Maintenance System Status indicator
 - If any of the Inspection/Maintenance System Status display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) for the indicator which did not display YES. The Inspection/Maintenance System DTC Table identifies the DTCs associated with each Inspection/Maintenance System Status Indicator. Follow the Conditions for Running the DTC in order to set the associated status indicator.

NOTE: An I/M Test DTC will not be stored or erased from the ECU except at the end of trip processing which occurs 5 s after ignition OFF.

22. Observe the I/M Test DTC information with a scan tool. Verify there are no I/M Test DTCs present.
 - If an I/M Test DTC is set, diagnose the DTC using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#), and refer to [Inspection/Maintenance System Check](#) for clearing I/M Test DTCs.
 - If an I/M Test DTC is set and the I/M System Status indicators are NO, diagnosis the DTC and perform the [Inspection/Maintenance Complete System Set Procedure](#).
23. Observe the engine DTC information with a scan tool. Verify no DTCs are present.
 - If a DTC is set, diagnose using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#). After repairs, perform the [Inspection/Maintenance Complete System Set Procedure](#) to verify no further DTCs are set.

POOR FUEL FILL QUALITY

Problem	Causes
DEFINITION: During the fueling process a continual, occasional, or no-fuel nozzle shut-off condition has occurred.	
Difficult to fill	• Fuel fill limiter vent valve stuck closed • Evaporative emission (EVAP) canister restricted • EVAP vent valve stuck closed • Hose between canister and canister vent solenoid twisted or kinked if applicable • High fuel temperature • Fuel filler hose is kinked • Faulty dispensing nozzle • Ignition switch ON, vent valve closed
Over fill	• Fill limiter vent valve stuck open or leaking • Fuel inlet check valve stuck open

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

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

System	DTCs Required to Set System Status to YES
If an I/M System Status indicator did NOT update to YES during the Inspection/Maintenance Complete System Set Procedure, review each indicator and reference this table to determine each DTC associated with the I/M System Status Indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs, which if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the Conditions for Running for each DTC listed below will allow the I/M System Status Indicators to transition to YES.	
Boost	<u>DTC P0234 or P0299</u>
Catalyst	<u>DTC P0420</u>
EGR/CMP	• <u>DTC P0011 or P0014</u> • <u>DTC P05CC or P05CE</u>
EVAP	• <u>DTC P0442</u> • <u>DTC P0446</u> • <u>DTC P0455</u>
Fuel System	• <u>DTC P219A</u> • <u>DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20</u> • <u>DTC P0234 or P0299</u>
HO2S Heater	<u>DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C</u>
HO2S/02S	• <u>DTC P0131, P0132, P015A, P015B, P223C, or P223E</u> • <u>DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271</u>

SERVICE BAY TEST

Diagnostic Instructions

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

Description

The purpose of the evaporative emission (EVAP) Service Bay Test is to aid in resetting the EVAP Inspection/Maintenance (I/M) System Status. For this vehicle, that is equipped with the engine off natural vacuum diagnostic, the Service Bay Test uses the scan tool to initiate the engine control module (ECM) regular sequence of EVAP system DTC tests, but with different enable criteria. By using the Service Bay Test the I/M indicator can be set without the need for multiple cold soaks.

The scan tool displays for the Service Bay Test are based on the events that occur within the following three categories:

EVAP Service Bay Test Status - Running

The vehicle must remain at rest, in Park, or in Neutral, during this portion of the test. This test inspects for large leaks and vent system restrictions. The purge valve leak diagnostic may run, but is not required. The scan tool will display test progress or the reason for an abort or failure.

EVAP Service Bay Test Status - Vehicle Ready for Drive Cycle

The scan tool will display time and distance needed to warm the fuel. The drive distance remaining rounds down to zero when there is anything less than 1 mile or kilometer remaining. The vehicle must be driven until the "return to service bay" message is displayed.

EVAP Service Bay Test Status - Engine Off Conditions Met

During this portion of the test, the ECM will remain active for up to 45 min when the ignition is turned OFF to allow control of the EVAP vent solenoid valve and run the engine off natural vacuum test. The ECM inspects for small leaks during this period by monitoring fuel tank pressure or vacuum. If the system is sealed, there will be a pressure or vacuum change. Pressure or vacuum changes that are not within the calibrated values indicate a leak.

NOTE:

- **Do not reorder the scan tool screen display. The EVAP Service Bay Test Status parameter is the main status message to observe. It will indicate when each category is active with the Test Results status parameter right beneath it.**
- **There are many possible screen messages. It is very important that you watch these messages and record any failure or abort message as this will aid the diagnosis.**
- **If any of these issues occur during or after the engine running portion of the test, the vehicle will need to soak for at least 8 h before retrying.**
- **An incorrect "drive distance not met" message is an indication that the service bay test aborted earlier and the vehicle was keyed off followed by retrying without waiting for at least 10 min before retrying.**

When the EVAP diagnostics are initiated by the Service Bay Test, the scan tool will indicate if the enable conditions listed below are not met, or will display a specific reason if the test aborts. When complete, the display will indicate that the tests completed or failed.

If

- The Service Bay Test aborts
- The scan tool resets
- The scan tool locks up

- The scan tool sets an error
- The diagnostic connector becomes disconnected

Before starting the engine, the vehicle should be left keyed off for at least 10 min before retrying.

After the ignition off portion of the test has completed, the Service Bay Test will delay ECM shut down for 10 min to allow for analysis of scan tool data. A complete Test Results status message along with EVAP Monitor Complete value of YES is the goal.

Conditions for Running the Test

The following conditions must be met in order to enable the Service Bay Test:

- The battery voltage is between 11 - 32 V.
- The engine coolant temperature (ECT) is less than 35Â°C (95Â°F) at start-up.
- The intake air temperature (IAT) is less than 34Â°C (93Â°F) at start-up.
- The ambient air temperature is between 0 - 40Â°C (32 - 104Â°F) at start-up.
- The fuel level is within 10 - 90% capacity and cannot be refueled during the tests.
- The vehicle must have sat for 8 h since the last run time.
- The EVAP I/M System Status indicator is set to NO.

NOTE: The use of the scan tool Clear DTCs function will reset all I/M statuses.

- There are no DTCs displayed.
- The vehicle must be driven for the time and distance specified on the scan tool.
- The ignition must remain OFF during the engine OFF portion of the test, and the vehicle must remain at rest.

Test Procedure

NOTE:

- If the Service Bay Test aborts or fails, a DTC will NOT be set.
- You must not rush the scan tool selections or erroneous results or error messages could occur.

1. Select the Service Bay Test with the scan tool.

WARNING: Refer to [Road Test Warning](#) .

2. Follow the instructions on the scan tool. The EVAP Service Bay Test should complete and should not abort or fail.

- **If the test aborts**

Correct the condition for running the test, then retest.

or

- **If the test fails**

Repair the vehicle for the condition indicated by the failure message, then retest.

- **Go to next step: If the test passes**

NOTE: There are several test parameters displayed and can vary by engine RPO.

3. Verify that the EVAP Monitor Complete parameter, is set to YES.

mcx30.com