Engine Controls Diagnostic (DTC P0172 To DTC P0455) - 5.7L - Corvette

DIAGNOSIS

DTC P0172 OR P0175

Circuit Description

The powertrain control module (PCM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop the PCM determines fuel delivery based on sensor signals without oxygen sensor (O2S) input. During Closed Loop, the oxygen sensor inputs are added and used by the PCM to calculate short and long term fuel trim fuel delivery adjustments. If the O2S indicate a lean condition, the fuel trim values will be above 0 percent. If the O2S indicate a rich condition, the fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. Long term fuel trim makes coarse adjustments in order to maintain an air/fuel ratio of 14.7:1. The fuel trim diagnostic will conduct a test to determine if a rich failure actually exists, or if excessive vapor from the evaporative emission (EVAP) canister is causing a rich condition. If the PCM detects an excessively rich condition, DTC P0172 or P0175 sets.

Conditions for Running the DTC

- DTCs P0101, P0103, P0108, P0135, P0137, P0141, P0200, P0300, P0410, P0420, P0430, P0440, P0442, P0443, P0446, P0449, P0506, P0507 or P1441 are not set.
- The engine coolant temperature (ECT) is between 75-115°C (167-239° F).
- The intake air temperature (IAT) is between -20 to +90°C (4-194°F).
- The manifold absolute pressure (MAP) is between 26-90 kPa (3.7-13 psi).
- The vehicle speed is less than 137 km/h (85 mph).
- The engine speed is between 400-3,000 RPM.
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The mass airflow (MAF) is between 5-90 g/s.
- The fuel level is more than 10 percent.
- The throttle position (TP) is less than 90 percent.

Conditions for Setting the DTC

- The average long term fuel trim value is below -13 percent.
- All of the above conditions are present for 40 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition

cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Fuel contamination, such as water or alcohol will effect fuel trim.
- A malfunctioning mass air flow sensor can cause a rich condition and set this DTC. Refer to **DTC P0101** .
- Use a scan tool in order to review Failure Records. If an intermittent condition is suspected, refer to **Intermittent Conditions** .

Test Description

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

5: If conditions were not corrected, refer to Fuel System Diagnosis for a possible fuel problem.

6: An EVAP canister that is saturated will cause a rich condition. If the conditions were not corrected, a worn cam, worn intake or exhaust valves, or other engine mechanical failure may be the problem.

DTC P0172 or P0175

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **If any DTCs other than P0172 are set, refer to those DTCs before continuing.** 1. Install scan tool. 2. Start and idle the engine at the normal operating temperature in Closed Loop.			

2	3. Record the long term fuel trim data. 4. Turn OFF the engine. 5. Turn ON ignition, with the engine OFF. 6. Review the Freeze Frame/Failure Records, and record the displayed data for this DTC. Does the scan tool indicate that the long term fuel trim is less than the specified value?	-13%	Go to **Step 3**	Go to Diagnostic Aids
3	1. Operate engine at idle. 2. Observe HO2S parameters with a scan tool. Does the scan tool indicate that the values are within the specified range and fluctuating?	200-800 mV	Go to **Step 4**	Go to **Step 5**
4	1. Turn OFF engine. 2. Visually and physically inspect the following items: • The EVAP lines and components for damage or blockage-Refer to **Evaporative Emissions (EVAP) Hose Routing Diagram** . • The inlet screen of the MAF sensor for blockage • The vacuum hoses for splits, kinks, and proper connections-Refer to **Emission Hose Routing Diagram** . • The air intake duct for being collapsed or restricted • The air filter for being dirty or restricted • Inspect for objects blocking the throttle body. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Step 6**
5	1. Turn OFF engine 2. Inspect the HO2S for proper installation. 3. Inspect to ensure that the electrical connectors and the wires are secure and not contacting the exhaust system. 4. Test for continuity between the signal circuit and the low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 7**	Go to **Fuel System Diagnosis**
6	Inspect for the following: • Excessive fuel in the crankcase • Proper operation of the fuel pressure regulator-Refer to **Fuel System Diagnosis** . • All injectors are functioning properly-Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 7**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical
7	**IMPORTANT:** **After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0200

Circuit Description

The control module enables the appropriate fuel injector on the intake stroke for each cylinder. Ignition 1 voltage is supplied to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. The control module monitors the status of each driver. If the control module detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.

- The ignition voltage is between 6-18 volts.

Conditions for Setting the DTC

- The powertrain control module (PCM) detects an incorrect voltage on a fuel injector control circuit.
- The condition exists for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Performing the Fuel Injector Coil Test may help to isolate an intermittent condition. Refer to **Fuel Injector Coil Test** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

5: This step verifies that the PCM is able to control the fuel injector.

6: This step tests if a ground is constantly being applied to the fuel injector.

DTC P0200

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
	Did you perform the Diagnostic System Check-Engine		Go to **Diagnostic**

1	Controls?	Go to**Step 2**	**System Check - Engine Controls**
2	1. Clear the DTCs with a scan tool. 2. Idle the engine at the normal operating temperature. 3. Monitor the misfire current counters with a scan tool. Are any of the misfire current counters incrementing?	Go to**Step 4**	Go to**Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to**Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the injector which displays the highest number of misfire current counters. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the fuel injector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to**Step 5**	Go to **Step 11**
5	1. Connect the **J 34730-2C** Fuel Injector Test Lamp between the control circuit of the fuel injector and the ignition 1 voltage circuit of the fuel injector. 2. Start the engine. Does the test lamp flash?	Go to **Step 9**	Go to**Step 6**
6	Does the test lamp remain illuminated?	Go to **Step 8**	Go to**Step 7**
7	Test the fuel injector control circuit for the following conditions: • A short to voltage • An open • High resistance		

	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to**Step 10**
8	Test the fuel injector control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Test for an intermittent and for a poor connection at the fuel injector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to**Step 12**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	**IMPORTANT:** **The INJ fuse also supplies voltage to the ignition coil modules. If the fuse is open, inspect all related circuits and components for a short to ground. Refer to Circuit Testing in Wiring Systems.** Test the ignition 1 voltage circuit of the fuel injector for: • An open • High resistance • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to**Step 14**	-
12	Replace the fuel injector. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.		

	Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0220

Circuit Description

The throttle position (TP) sensor is mounted on the throttle body assembly. The sensor is actually 2 individual TP sensors within 1 housing. Two separate signal, low reference and 5-volt reference circuits are used in order to connect the TP sensor assembly to the throttle actuator control (TAC) module. The 2 sensors have opposite functionality. The TP sensor 1 signal voltage is pulled up to the reference voltage as the throttle opens, from below 1 volt at closed throttle to above 3.5 volts at wide open throttle (WOT). The TP sensor 2 signal voltage is pulled down to the low reference from around 3.8 volts at closed throttle to below 1 volt at WOT. TP sensor 1 and accelerator pedal position (APP) sensor 1 share a 5-volt reference circuit that is connected within the TAC module. TP sensor 2 and APP sensor 2 share a 5-volt reference circuit that is connected within the TAC module. If an out of range condition is detected with the TP sensor 2, this DTC will set and the Reduced Engine Power message will be displayed.

Conditions for Running the DTC

- DTCs P2108, or P1518 are not set.
- The ignition switch in the crank position or the run position.
- The ignition voltage is greater than 5.23 volts.

Conditions for Setting the DTC

- The TP sensor 2 voltage is less than 0.13 volts or greater than 4.87 volts.
- All above conditions present for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- 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

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the TAC module connectors for signs of water intrusion. When water intrusion occurs, multiple DTCs could be set with no DTC circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC System, more than one TAC System related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Keep this in mind when reviewing the Capture Info.
- If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

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

12: Using a test lamp reduces the amount of current fed into the signal circuit. The scan tool should display the maximum value for this parameter, 5-volts even though the actual voltage is higher.

18: The TP 2 sensor and the APP 2 sensor share a common 5 volt reference. The 5-volt reference circuits are connected internally within the TAC module. Disconnecting the TAC module will isolate the 5-volt reference circuits.

19: The TP sensor 2 and the APP sensor 2 share a common 5-volt reference. A short to voltage on the APP sensor 2 5-volt reference circuit will affect the TP sensor 2 5-volt reference circuit.

36: When the TAC module detects a condition within the TAC system, more than 1 TAC system related DTC may set. This condition is due to the many redundant tests that run continuously on this system. Locating and repairing 1 individual condition may correct more than 1 DTC. Disconnecting components during testing may set additional DTCs. Keep this in mind when reviewing the Capture Info.

DTC P0220

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View References: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P1515, P1516, or P1518 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**

3	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body assembly. 3. Disconnect the throttle actuator motor harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Manually close the throttle blade completely while observing the throttle position (TP) sensor 2 voltage parameter on the scan tool. Does the scan tool indicate that the TP sensor 2 voltage is within the specified values?	4.3-4.8 V	Go to **Step 4**	Go to **Step 7**
4	Open the throttle blade to wide open throttle (WOT) by hand while observing the TP sensor 2 voltage parameter on the scan tool. Does the scan tool indicate TP sensor 2 voltage within the specified values?	0.13-1 V	Go to **Step 5**	Go to **Step 7**
5	1. Turn OFF the ignition for 15 seconds. 2. Reconnect the throttle actuator motor harness connector. 3. Reinstall the air inlet duct. 4. Turn ON the ignition with the engine OFF. 5. Select the DTC Info. Option on the scan tool. 6. Lightly touch and move the related engine wiring harnesses and connectors for the throttle position (TP) sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 6**
6	1. Continue to observe DTC Info. 2. Slowly depress the accelerator pedal to WOT and then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	-	Go to **Step 26**	Go to Diagnostic Aids
7	Observe the TP sensor 2 voltage parameter, with a scan tool. Does the scan tool indicate that the TP sensor 2 voltage is at the specified value?	5 V	Go to **Step 8**	Go to **Step 12**
	Disconnect the TP sensor harness connector.			

8	Does the scan tool indicate that the TP sensor 2 voltage is at the specified value?	0 V	Go to **Step 9**	Go to **Step 13**
9	1. Disconnect the accelerator pedal position (APP) sensor harness connector. 2. Turn ON the ignition with the engine OFF. 3. Test the TP sensor 2 5-volt reference circuit for voltage, with a DMM. Does the DMM indicate voltage near the specified value?	5 V	Go to **Step 10**	Go to **Step 18**
10	With a DMM connected between the TP sensor 1 low reference circuit and the TP sensor 2 low reference circuit at the TP sensor harness connector, test for resistance Does the DMM indicate resistance within the specified values?	0-5 ohm	Go to **Step 14**	Go to **Step 11**
11	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor 2 low reference circuit for an open or for high resistance, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 32**
12	1. Disconnect the TP sensor harness connector. 2. Connect a test lamp between the TP sensor 2 signal circuit and the battery positive voltage. Does the scan tool indicate TP sensor 2 voltage near the specified value?	5 V	Go to **Step 20**	Go to **Step 15**
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition. 4. Test the TP sensor 2 signal circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 17**
	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits.			

14	3. Turn ON the ignition with the engine OFF. 4. Test the APP sensor 2 signal circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 24**
15	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 2 signal circuit for an open or for high resistance, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 16**
16	Test the TP sensor 2 signal circuit for a short to ground, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 17**
17	Test for a short between the TP sensor 2 signal circuit and all other TAC module circuits, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 32**
18	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition with the engine OFF. 4. Test the TP sensor 2 5-volt reference circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 19**
19	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Turn ON the ignition with the engine OFF. 4. Test the APP sensor 2 5-volt reference circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 24**
	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector			

20	containing the TP sensor circuits. 3. Test the TP sensor 2 5-volt reference circuit for an open or for high resistance, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 21**
21	Test the TP sensor 2 5-volt reference circuit for a short to ground, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 22**
22	1. Disconnect the APP sensor harness connector. 2. Disconnect the other TAC module harness connector. 3. Turn ON the ignition with the engine OFF. 4. Test the APP sensor 2 signal circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 23**
23	Test the APP sensor 2 5-volt reference circuit for a short to ground, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 24**
24	Test the TP sensor 2 5-volt reference circuit for a short to voltage, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 25**
25	Test for a short between the TP sensor 2 5-volt reference circuit and all other TAC module circuits, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 26**
26	Test for a short between the APP sensor 2 5-volt reference circuit and all other TAC module circuits, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 27**
27	Test the TP sensor 2 signal circuit for high resistance, with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 28**
28	Test the TP sensor 2 low reference circuit for resistance, with a DMM. Refer to **Circuit Testing** and **Wiring**	-		

	Repairs in Wiring Systems. Did you find and correct the condition?		Go to **Step 35**	Go to **Step 29**
29	1. Reconnect the TAC module connectors. 2. Turn ON the ignition. 3. Measure the voltage at the TP sensor 2 5-volt reference circuit, with a DMM. Does the DMM indicate voltage greater than the specified value?	6.06 V	Go to **Step 32**	Go to **Step 30**
30	1. Turn OFF the ignition. 2. Connect a test lamp between APP sensor 2 5-volt reference and battery positive voltage. Does the test lamp illuminate?	-	Go to **Step 32**	Go to **Step 31**
31	Inspect for poor connections at the TP sensor harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 33**
32	Inspect for poor connections at the TAC module harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 34**
33	**IMPORTANT:** **The TP sensor is not a serviceable part and should only be replaced with the throttle body assembly.** Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** .Did you complete the replacement?	-	Go to **Step 35**	-
34	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
35	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC run and pass?	-	Go to **Step 36**	Go to **Step 2**

36	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0230

Circuit Description

When the ignition switch is turned ON, the control module enables the fuel pump relay, which supplies current to the fuel pump. The fuel pump remains enabled as long as the engine is cranking or running and the control module receives ignition reference pulses. If there are no ignition reference pulses, the control module shuts the fuel pump OFF approximately 2 seconds after the ignition was switched to the ON position or if the engine stops. The control module monitors the voltage on the fuel pump relay control circuit. If the control module detects an incorrect voltage on the fuel pump relay control circuit, a fuel pump relay control DTC sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The ignition voltage is between 6-18 volts.

Conditions for Setting the DTC

- The Powertrain Control Module (PCM) detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 2.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

DTC P0230

Fuel Pump Relay Underhood Electrical Center Terminal Identification			
Front of vehicle			
Left side of vehicle	Ground	Ignition	Right side of vehicle
	Fuel Pump Supply	Control	

Test Description

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

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

5: This step tests for an open in the ground circuit to the fuel pump relay.

6: This step tests if the voltage is constantly being applied to the control circuit of the fuel pump relay.

DTC P0230

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF when commanded with a scan tool?	Go to**Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to**Intermittent Conditions**
	1. Turn OFF the ignition. 2. Remove the fuel pump relay.		

4	3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. 5. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to**Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to **Step 9**	Go to **Step 11**
6	Does the test lamp remain illuminated?	Go to **Step 8**	Go to **Step 7**
7	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to**Step 10**
8	Test the control circuit of the fuel pump relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the fuel pump relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Test the ground circuit of the fuel pump relay for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	-
12	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 14**	-
	Replace the PCM. Refer to **Powertrain Control**		

13	**Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0300

System Description

The powertrain control module (PCM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor in order to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the PCM is able to detect individual misfire events. A misfire rate that is high enough can cause the 3-way catalytic converter (TWC) to overheat under certain driving conditions. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for TWC overheating are present. If the PCM detects a misfire rate sufficient to cause emission levels to exceed mandated standards, DTC P0300 will set.

Conditions for Running the DTC

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0125, P0128, P0335, P0336, P0341, P0342, P0343, P0410, P0500, P0502, P0503, P1114, P1115, P1120, and P1220 are not set.
- The engine speed is between 425-3,000 RPM.
- The ignition voltage is between 10-18 volts.
- The engine coolant temperature (ECT) is between -7 and +130°C (19-266°F).
- The fuel level is more than 10 percent.
- The throttle angle is steady within 1 percent.
- The antilock brake system (ABS) and the traction control system are not active.
- The transmission is not changing gears.
- The A/C clutch is not changing states.
- The PCM is not in fuel shut-off or decel fuel cut-off mode.
- The PCM is not receiving a rough road signal.

Conditions for Setting the DTC

The PCM is detecting a crankshaft rotation speed variation indicating a misfire sufficient to cause emission levels to exceed mandated standards.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Excessive vibration from sources other than the engine could cause DTC P0300 to set. The following are possible sources of vibration:
  - Variable thickness brake rotors-Refer to **Symptoms - Hydraulic Brakes** in Hydraulic Brakes.
  - Drive shaft not balanced-Refer to **Vibration Analysis - Driveline** in Vibration Diagnosis and Correction.
  - Worn or damaged accessory drive belt-Refer to **Base Engine Misfire without Internal Engine Noises** in Engine Mechanical.
- There may be more or less cylinders actually misfiring than indicated by the scan tool.
- Spray water on the secondary ignition components using a spray bottle. Look and listen for arcing or misfiring.
- If there are multiple misfires on only one bank, inspect the fuel injector and ignition coil, power and ground circuits for that bank. Refer to **Engine Controls Schematics** .

Test Description

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

2: If the actual CKP variation values are not within the learned values, the misfire counters may increment.

3: DTC P0135 or P0155 can be set because of a misfire.

DTC P0300

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **You must perform the crankshaft position (CKP) system variation learn procedure before proceeding with this diagnostic table. Refer to CKP System Variation Learn Procedure .** 1. Start the engine. 2. Allow the engine to idle or operate within the conditions listed in the Freeze Frame/Failure Records. 3. Monitor all of the misfire counters with the scan tool. Are any of the current misfire counters incrementing?	-	Go to **Step 3**	Go to Diagnostic Aids
3	Are any DTCs other than P0300, P0135 or P0155 set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	Can any abnormal engine noise be heard?	-	Go to **Base Engine Misfire without Internal Engine Noises**	Go to **Step 5**
5	Does the scan tool indicate that the HO2S bank 1 sensor 1 or HO2S bank 2 sensor 1 voltage parameters are below the specified value?	200 mV	Go to **DTC P0131 or P0151**	Go to **Step 6**
6	Does the scan tool indicate that the HO2S bank 1 sensor 1 or HO2S bank 2 sensor 1 voltage parameters are fixed above the specified value?	900 mV	Go to **DTC P0132 or P0152**	Go to **Step 7**
	Inspect the following components: • The vacuum hoses and seals for splits, restrictions, and improper connection-Refer to **Emission Hose Routing Diagram** . • The throttle body and intake manifold for vacuum leaks • The crankcase ventilation system for vacuum leaks-Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • The PCM grounds for corrosion and loose			

7	connections-Refer to **Ground Distribution Schematics** in Wiring Systems. • The exhaust system for restrictions-Refer to **Restricted Exhaust** in Engine Exhaust. • The fuel for contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Disconnect the spark plug wire from the spark plug that corresponds to the Misfire Current counters that were incrementing. Refer to **Spark Plug Wire Replacement** . 3. Install the **J 26792** Spark Tester to a good ground. 4. Start the engine. Does the spark jump the tester gap, and is the spark consistent?	-	Go to **Step 10**	Go to **Step 9**
9	1. Remove the spark plug wire for the affected cylinder. Refer to **Spark Plug Wire Replacement** . 2. Inspect the spark plug wire. Refer to **Spark Plug Wire Inspection** . 3. Measure the resistance of the spark plug wire with a DMM. Is the spark plug wire resistance less than the specified value?	700 ohm	Go to **Electronic Ignition (EI) System Diagnosis**	Go to **Step 19**
10	1. Remove the spark plug from the cylinders that indicated a misfire. 2. Inspect the spark plug. Refer to **Spark Plug Inspection** . Does the spark plug appear to be OK?	-	Go to **Step 11**	Go to **Step 12**
11	1. Exchange the suspected spark plug with another cylinder that is operating properly. Refer to **Spark Plug Replacement** . 2. Operate the vehicle under the same conditions	-		

	that the misfire occurred. Did the misfire move with the spark plug?		Go to **Step 18**	Go to **Step 15**
12	Are the spark plugs oil or coolant fouled?	-	Go to **Base Engine Misfire without Internal Engine Noises**	Go to **Step 13**
13	Are the spark plugs gas fouled?	-	Go to **Step 16**	Go to **Step 14**
14	Do the spark plugs show any signs of being cracked, worn, or improperly gapped?	-	Go to **Step 17**	Go to **Step 15**
15	Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 20**	Go to **Base Engine Misfire without Internal Engine Noises**
16	Perform the fuel system diagnosis. Refer to **Fuel System Diagnosis** . Did you find and correct the condition?	-	Go to **Step 20**	Go to **Base Engine Misfire without Internal Engine Noises**
17	Replace or gap the spark plug. Refer to **Spark Plug Replacement** . If an improper gap is found, be sure to gap the spark plugs using a wire type gage. Did you complete the replacement?	-	Go to **Step 20**	-
18	Replace the faulty spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the faulty spark plug wire. Refer to **Spark Plug Wire Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
20	Was the customer concern the MIL flashing?	-	Go to **Step 21**	Go to **Step 22**
21	1. Operate the vehicle at the specified value for 4 minutes. 2. Operate the vehicle within the Conditions for Running the DTC P0420 or P0430 as specified in the supporting text. Refer to **DTC P0420 or P0430** . Does the DTC run and pass?	2500 RPM	Go to **Step 22**	Go to **DTC P0420 or P0430**
22	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 23**
23	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0315

Circuit Description

The Crankshaft Position (CKP) System Variation Learn feature is used to calculate reference period errors caused by slight tolerance variations in the crankshaft, and the crankshaft position sensor. The calculated error allows the powertrain control module (PCM) to accurately compensate for reference period variations. This enhances the ability of the PCM to detect misfire events over a wider range of engine speed and load.

The PCM stores the crankshaft position system variation values after a learn procedure has been performed. If the actual crankshaft position variation is not within the crankshaft position system variation compensating values stored in the PCM, DTC P0300 may set. If the PCM detects the CKP system variation values are not stored in the PCM memory, DTC P0315 sets.

Conditions for Running the DTC

- DTCs P0335, P0336, P0341, P0342, P0343 are not set.
- The engine coolant temperature is more than 70°C (158°F).

Conditions for Setting the DTC

The CKP system variation values are not stored in the PCM memory.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0315

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Perform the Crankshaft Position System Variation Learn Procedure. Refer to **CKP System Variation Learn Procedure** . Does the scan tool display Learned This Ignition?	Go to **Step 4**	Go to **Step 3**
3	If the Crankshaft Position System Variation Learn Procedure cannot be performed successfully, inspect for the following conditions: • Worn crankshaft main bearing • A damaged reluctor wheel • Excessive crankshaft runout • A damaged crankshaft • Any foreign material passing between the crankshaft position (CKP) sensor and the reluctor wheel • Interference in the signal circuit of the CKP sensor • A coolant temperature that is not within the Condition for Running the DTC • The ignition switch is in the ON position until the battery has insufficient voltage • A powertrain control module (PCM) power disconnect with the ignition ON may erase the stored value and set the DTC P0315 Did you complete the inspection?	Go to **Step 4**	-
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0325

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. The powertrain control module (PCM) calculates the average voltage range of each KS signal. If the KS system is operating normally, the PCM should monitor the KS voltage varying above and below a calculated average voltage. This DTC will set if the PCM malfunctions in a manner that will not allow proper diagnosis of the KS system.

Conditions for Running the DTC

- Engine run time is more than 10 seconds.
- Ignition voltage is more than 10 volts.

Conditions for Setting the DTC

- A malfunction with the KS system within the PCM are faulty.
- All of the above conditions are present for 12 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0325

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **If you can hear the engine knock, repair the engine**		

2	**mechanical problem before proceeding with this diagnostic.** 1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn off the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or as close to the Freeze Frame/Failure Records data that you observed Does the DTC fail this ignition?	Go to **Step 3**	Go to**Intermittent Conditions**
3	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 4**	-
4	1. Use the scan tool in order to clear the DTCs 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the conditions for Running the DTC as specified in the supporting text. Does the scan tool indicate that this test ran and passed?	Go to **Step 5**	Go to **Step 2**
5	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0327 OR P0332

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. The powertrain control module (PCM) calculates the average voltage range of each KS signal. If the KS system is operating normally, the PCM should monitor the KS voltage varying above and below calculated average voltage. If the PCM detects a KS-1 signal or a KS-2 signal voltage within the calculated average range, a DTC will be set. DTC P0327 refers to the front knock sensor. DTC P0332 refers to the rear knock sensor.

Conditions for Running the DTC

- DTCs P0117, P0118, P0121, P0122, P0123, P0125, P1114, P1115, P1121 or P1122 are not set.
- The minimum noise level must be learned. The minimum noise level is learned when the following

conditions are met:
    - The ECT must be greater than 60°C (140°F).
    - The engine RPM is between 475-975 for 10 seconds.
- Engine speed is between 1500 RPM and 3,000 RPM.
- Map is less than 49 kPa.
- Engine coolant temperature (ECT) is more than 60°C (140°F).
- Throttle angle is more than 0 percent.
- Engine run time is more than 10 seconds.
- Ignition voltage is more than 10 volts.

Conditions for Setting the DTC

The PCM determines that this signal is less than the expected amount for more than 9 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: If the knock sensor is dropped, it must be replaced.

- Check the knock sensor for proper installation. A knock sensor that is loose or over torqued may cause the DTC to set.
- If DTCs P0327 and P0332 are set at the same time, inspect for poor connections at the KS harness jumper, located at the left rear side of the intake manifold.
- For an intermittent, refer to **Intermittent Conditions** .

Test Description

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

2: This verifies the malfunction is present.

3: This test will isolate the knock sensor from the rest of the circuit.

4: Tapping on the engine block will simulate an engine knock.

DTC P0327 or P0332

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If an engine knock can be heard, repair the engine mechanical condition before proceeding with this diagnostic.** 1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the engine within the Conditions for Running the DTC as close to the Freeze Frame/Failure Records data that you observed. Does the scan tool indicate that this diagnostic failed this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Remove the left engine sight shield. 2. Disconnect the knock sensor (KS) jumper harness connector located on the left side of the intake manifold. 3. Set the DMM to the 400K ohm scale. 4. Measure the resistance of the affected KS using the DMM connected to battery ground. Is the resistance of the knock sensor within the specified range?	93-107K ohm	Go to **Step 4**	Go to **Step 6**

4	1. Connect the DMM between the affected KS signal circuit on the sensor side and a good ground. 2. Set the DMM to the 400 mV AC hertz scale. Refer to **Measuring Frequency** in Wiring Systems. **IMPORTANT:** **Do not tap on plastic engine components.** 3. Tap on the engine block near the affected KS while observing the signal indicated on the DMM. Is any signal indicated on the DMM while tapping on the engine block near the KS?	-	Go to **Step 5**	Go to **Step 7**
5	1. Disconnect the PCM connector. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Test the KS signal circuit between the PCM and the KS jumper harness connector for the following: • An open or high resistance • A short to voltage • A short to ground Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
6	1. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical. 2. Test for an open, high resistance or a short to ground in the signal circuit between the knock sensor jumper harness connector, located at the left side of the intake manifold and the KS connector. Refer to **Testing for Continuity** or **Testing for Short to Ground** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
7	1. Inspect the KS signal circuit for a poor connection at the affected KS. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. If you find a poor connection repair the connector as necessary. Refer to **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 12**	Go to **Step 8**
8	Replace the KS. Refer to **Knock Sensor (KS) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
9	1. Inspect the KS signal circuit for a poor connection at the KS jumper harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. If you find a poor connection, repair the connector as necessary. Refer to **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
10	1. Inspect the KS signal circuit for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. If you find a poor connection, repair the connector as necessary. Refer to **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0335

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor is connected directly to the powertrain control module (PCM) and consists of the following circuits:

- The 12-volt reference circuit
- The low reference circuit
- The CKP sensor signal circuit

If the PCM detects no signal from the CKP sensor for less than 4 seconds.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0341, P0342, or P0343 are not set.
- The camshaft position (CMP) sensor is in transition.
- The mass airflow (MAF) is more than 3 grams per second.
- The ignition switch is in the crank mode.

Conditions for Setting the DTC

The PCM does not receive signals from the CKP sensor for less than 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

6: This step simulates a CKP sensor signal to the PCM. If the PCM receives the signal, the fuel pump will operate for 2 seconds. If the fuel pump operates, the condition involves terminal contact at one of the following components:

- The CKP sensor

- The CKP sensor reluctor wheel

DTC P0335

Step	Action	Value	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Does the engine start and continue to run?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn ON the ignition, with the engine OFF. 2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Disconnect the CKP sensor. 4. Measure the voltage from the 12-volt reference circuit of the CKP sensor to a good ground with a DMM. Does the DMM display the specified value?	B+	Go to **Step 5**	Go to **Step 7**
5	Measure the voltage between the 12-volt reference circuit and the low reference circuit with the DMM. Does the DMM display the specified value?	B+	Go to **Step 6**	Go to **Step 8**
6	Connect the test lamp between the CKP sensor signal circuit and the 12-volt reference of the CKP sensor. Does the fuel pump operate if you apply the ignition voltage to the CKP sensor signal circuit?	-	Go to **Step 11**	Go to **Step 9**
7	Test for an open or short to ground in the 12-volt reference circuit of the CKP. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
8	Test for an open CKP low reference circuit. Refer to **Circuit Testing** or **Wiring Repairs** in Wiring	-		

	Systems. Did you find and correct the condition?		Go to **Step 15**	Go to **Step 14**
9	Test the CKP sensor signal circuit for the following conditions: • An open • A short to ground • A short to voltage Refer to **Testing for Intermittent Conditions and Poor Connections** and **Circuit Testing** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
10	Test for poor connections at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
11	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Inspect the CKP Sensor for the following conditions: • Excessive air gap between the CKP sensor and the reluctor wheel • Physical damage • Improper installation • Electromagnetic interference in the CKP sensor circuits • Foreign material passing between the CKP sensor and the reluctor wheel 3. If you locate a condition, repair the condition as necessary. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
12	Test the CKP sensor reluctor wheel for the following conditions: • Physical damage • Improper installation • Excessive endplay or looseness	-		

	Refer to **Crankshaft and Bearings Removal** in Engine Mechanical. Did you find and correct the condition?		Go to **Step 15**	Go to **Step 13**
13	Replace the CKP Sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the repair?	-	Go to **Step 16**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the repair?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0336

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor is connected directly to the powertrain control module (PCM) and consists of the following circuits:

- The 12-volt reference circuit
- The low reference circuit
- The CKP sensor signal circuit

If the PCM detects that the CKP sensor is inconsistent for less than 2 seconds.

Conditions for Running the DTC

The engine is cranking or running.

Conditions for Setting the DTC

The PCM determines that the CKP sensor signal is for less than 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

3: This step tests for electromagnetic interference (EMI) on the CKP sensor circuits.

6: Vertical lines across the face of the sensor may indicate foreign material passing between the CKP sensor and the reluctor wheel. Lines which are not vertical across the face of the sensor may indicate a crack in the CKP sensor. Either of these conditions will cause this DTC to set.

7: Damage to the reluctor wheel can affect the CKP sensor output.

DTC P0336

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Before proceeding with this DTC, diagnose DTC P0335, if active.** 1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 3**	Go to **Intermittent Conditions**
3	1. Inspect the CKP sensor for circuit harnesses and for wires that are routed too close to the following components: • The wires to other components, or the secondary ignition wires • Aftermarket add-on electrical equipment • The solenoids • The relays • The motors 2. Inspect for incorrect harness routing. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 4**
4	Test for poor connections at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 5**
5	Test for poor connections at the PCM for the CKP sensor circuits, refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Inspect the CKP sensor for the following conditions: • Excessive air gap between the CKP sensor and the reluctor wheel • Foreign material passing between the CKP sensor and the reluctor wheel • Physical damage • Improper installation • Electromagnetic interference in the CKP sensor circuits Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
	Inspect the CKP reluctor wheel for the following conditions:		

7	• Physical damage • Improper installation • Excessive endplay or looseness Refer to **Crankshaft and Bearings Removal** in Engine Mechanical. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you find and correct the condition?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0341

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1 X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12 volt reference to the CMP sensor as well as a low reference and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads. The PCM uses this 1 X signal in combination with the crankshaft position (CKP) sensor signal in order to determine the CKP and stroke.

The CMP sensor 1 X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor signal alone. Observe that as long as the PCM receives the CKP sensor signal, the engine will start without a CMP signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that a CMP to CKP mis-match has

occurred DTC P0341 sets.

Conditions for Running the DTC

The engine is running and the engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that a CMP to CKP mis-match has occurred.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The following conditions may cause this DTC to set:

- Camshaft reluctor ring damage
- The sensor coming in contact with the reluctor ring
- Foreign material passing between the sensor and the reluctor ring
- Excessive camshaft end-play
- Wiring routed too close to secondary ignition components

If you suspect the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

3: This step inspects for electromagnetic interference (EMI) on the CMP sensor circuits.

6: Damage to the face of the sensor could indicate foreign material passing between the CMP sensor and the reluctor wheel. This condition would cause this DTC to set. Damage to the reluctor wheel would affect the CMP sensor output.

DTC P0341

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If DTC P0342 or P0343 are set diagnose those DTCs first. Refer to DTC P0342 and DTC P0343** 1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Visually and physically inspect all circuits going to the CMP sensor for the following: Refer to **Camshaft Position (CMP) Sensor Replacement** . • Being routed too close to secondary ignition wires or components • Being routed too close to after-market add-on electrical equipment • Being routed too close to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing Did you find and correct the condition?	Go to **Step 9**	Go to **Step 4**
4	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector**		

	Repairs in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Excessive wear of the sensor • Loose or improper installation Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
7	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Use the scan tool in order to clear any DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	Go to **Step 10**	Go to **Step 2**
10	Observe the Capture Info with a scan tool. Are there any DTC's that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0342

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1 X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12-volt reference to the CMP sensor as well as a low reference

and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads. The PCM uses this 1X signal in combination with the crankshaft position (CKP) sensor signal in order to determine the CKP and stroke.

The CMP sensor 1X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor signal alone. Observe that as long as the PCM receives the CKP sensor signal, the engine will start without a CMP signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that the CMP signal is constantly low, DTC P0342 sets.

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is low for 1.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The following conditions may cause this DTC to set:
  - Camshaft reluctor ring damage
  - The sensor coming in contact with the reluctor ring
  - Foreign material passing between the sensor and the reluctor ring
  - Excessive camshaft end-play
  - Wiring routed too close to secondary ignition components
- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

4: This step tests the CMP sensor and circuits from the CMP sensor to the PCM. If there is not duty cycle displayed or if the duty cycle is not within range there is a problem with the sensor or the circuits.

DTC P0342

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the camshaft position (CMP) sensor high to low and low to high transition parameter with a scan tool. Does the scan tool parameter increment?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
	1. Disconnect the powertrain control module (PCM). Refer to **Powertrain Control Module (PCM) Replacement** .			

4	2. Jumper the low reference circuit of the CMP sensor from the PCM connector to a good ground. Refer to **Using Connector Test Adapters** in Wiring Systems. 3. Jumper the 12-volt reference circuit of the CMP sensor from the PCM connector to battery voltage. Refer to **Using Connector Test Adapters** in Wiring Systems. 4. Measure the DC duty cycle on the signal circuit of the CMP sensor at the PCM connector with a DMM while cranking the engine. Is the duty cycle within the specified range?	45-55%	Go to **Step 9**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Connect the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 3. Remove fuel pump relay using a **J 43244** . 4. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical. 5. Disconnect the CMP sensor. 6. Turn ON the ignition, with the engine OFF. 7. Probe the 12-volt reference circuit of the CMP sensor with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 6**
6	Test the 12-volt reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 9**
7	Test the CMP sensor signal circuit for an open or for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 10**
	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent**			

9	**Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
10	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Loose or improper installation Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
11	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 12**
12	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0343

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12-volt reference to the CMP sensor as well as a low reference

and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads.

The CMP sensor 1X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that the CMP signal is constantly high, DTC P0343 sets.

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is high for 1.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The following conditions may cause this DTC to set:
    - Camshaft reluctor ring damage

- The sensor coming in contact with the reluctor ring
- Foreign material passing between the sensor and the reluctor ring
- Excessive camshaft end-play
- Wiring routed too close to secondary ignition components

- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

4: This step tests the CMP sensor and circuits from the CMP sensor to the PCM. If there is not duty cycle displayed or if the duty cycle is not within range there is a problem with the sensor or the circuits.

DTC P0343

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the camshaft position (CMP) sensor high to low and low to high transition parameter with a scan tool. Does the scan tool parameter increment?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
	1. Disconnect the powertrain control module (PCM). Refer to **Powertrain Control Module (PCM) Replacement** . 2. Jumper the low reference circuit of the CMP sensor from the PCM connector to a good ground. Refer to **Using Connector Test**			

4	**Adapters** in Wiring Systems. 3. Jumper the 12-volt reference circuit of the CMP sensor from the PCM connector to battery voltage. Refer to **Using Connector Test Adapters** in Wiring Systems. 4. Measure the DC duty cycle on the signal circuit of the CMP sensor at the PCM connector with a DMM while cranking the engine. Is the duty cycle within the specified range?	45-50%	Go to **Step 10**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Connect the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 3. Remove fuel pump relay using a **J 43244** . 4. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical. 5. Disconnect the CMP sensor. 6. Turn ON the ignition, with the engine OFF. 7. Probe the signal circuit of the CMP sensor with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Jumper the CMP circuits from the CMP sensor to the CMP sensor harness connector. Refer to **Using Connector Test Adapters** in Wiring Systems. 3. Turn ON the ignition with the engine OFF. 4. Measure the Voltage Drop from the low reference circuit of the CMP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 8**	Go to **Step 9**
7	Test the CMP sensor signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
	Test the low reference circuit for an open or high			

8	resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
11	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Loose or improper installation Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
12	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
13	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**

16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0351-P0358

Circuit Description

The ignition system on this engine uses an individual ignition coil for each cylinder. The powertrain control module (PCM) controls the ignition system operation. The PCM controls each coil using one of eight ignition control (IC) circuits. The PCM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- An ignition control (IC) circuit
- A low reference circuit

Sequencing and timing are PCM controlled. If the PCM detects that the IC circuit is out of range, DTC P0351-P0358 sets.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

The PCM detects the IC circuit is grounded, open, or shorted to voltage for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

3: This step verifies the integrity of the IC circuit and the PCM output.

4: This step tests for a short to ground on the IC circuit.

DTC P0351-P0358

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	1. Turn OFF the engine. 2. Disconnect the respective ignition coil. 3. Start the engine. 4. Measure the frequency at the IC circuit with the DMM set to DC Hertz. Refer to **Measuring Frequency** in Wiring Systems. Is the frequency within the specified range?	3-20 Hz	Go to **Step 7**	Go to **Step 4**
4	Measure the voltage from the IC circuit of the ignition coil to a good ground with the DMM. Is the voltage more than the specified value?	1 V	Go to **Step 13**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Disconnect the PCM connector.			

5	3. Test the IC circuit between the ignition coil connector and the PCM connector for continuity with the DMM. Does the DMM indicate continuity?	-	Go to **Step 6**	Go to **Step 14**
6	Test the respective IC circuit for a short to ground. Refer to **Testing for Short to Ground** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
7	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit of the ignition coil with a test lamp that is connected to battery ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 11**
8	Probe the ground circuit of the ignition coil with a test lamp connected to battery voltage. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 12**
9	Test for an intermittent and for a poor connection at the ignition coil. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
11	Repair the open in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
12	Repair the open in the ground circuit for the ignition coil. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
13	Repair the IC circuit for a short to voltage. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
14	Repair open in the IC circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
15	Replace the ignition coil. Refer to **Ignition Coil(s) Replacement** .	-		

	Did you complete the replacement?		Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0410

Circuit Description

The Secondary Air Injection (AIR) System is designed to lower exhaust emission levels on initial start up. The AIR pump runs until closed loop is achieved.

The powertrain control module (PCM) commands the AIR pump relay and the AIR vacuum solenoid ON simultaneously by supplying a ground on the AIR pump relay control circuit and a ground to the AIR vacuum solenoid control circuit. When engine vacuum is applied to the AIR shut-off valve, airflow from the AIR pump flows through the pipes/hoses to the exhaust check valves. The air enters the exhaust stream, accelerating catalyst operation. When inactive, the exhaust check valves and the AIR shut-off valve prevent airflow in either direction.

The PCM detects a system airflow problem by monitoring the heated oxygen sensors (HO2S) during normal AIR system operation. This is a passive test. If the passive test indicates a pass, the PCM takes no further action. If the passive test fails or is inconclusive, the diagnostic will proceed with an intrusive or active test. The PCM will command the AIR system ON during closed loop operation under normal operating conditions. The active test will pass or fail based on the response from the HO2S. A lean HO2S response indicates that the secondary AIR system is functioning normally. An increasing short term fuel trim (FT) value also indicates a normally functioning system. The AIR diagnostic consists of the passive test and the active tests. The AIR diagnostic requires failure of the passive and active tests on two consecutive key cycles to illuminate the MIL and store a DTC. If the PCM detects that the HO2S and Short Term FT did not respond as expected on both of the engine banks, DTC P0410 sets.

Conditions for Running the DTC

- DTCs P0101, P0102,P0103, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0125, P0128, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0335, P0336, P0351, P0352, P0353, P0354, P0355, P0356, P0357, P0358, P0442, P0443, P0455, P0446, P0449, P0496, P1133, P1134, P1153, P1154, P1235, P1258, P2135 are not set.
- The fuel level is more than 12.5 percent but less than 87.5 percent.
- The engine is running for more than 30 seconds.
- The mass air flow (MAF) is less than 23 g/s.
- The air fuel ratio is 14.7:1.
- The engine load is less than 40 percent.
- The ignition voltage is more than 11.7 volts.
- The vehicle speed is more than 25 km/h (15 mph).
- The engine is operating in closed loop for more than 15 seconds.
- The engine speed is more than 850 RPM.
- The engine coolant temperature (ECT) is between -10 and +110°C (+14 and +230°F).
- The intake air temperature (IAT) is between -10 and +100°C (+14 and +212°F).
- The fuel system is operating in fuel trim cells 1, 2, 3, 4 or 5.
- The short term FT is between -4 and +4 percent.
- The start-up engine coolant temp is less than 70°C (158°F).
- The engine is not operating in any of the following modes:
    - Power enrichment
    - Decel fuel cut-off mode
    - Catalyst over temperature

Conditions for Setting the DTC

- When the AIR pump is commanded ON, during closed loop operation and the HO2S voltages do not decrease below 222 mV for 1.5 seconds.
- The short term FT does not change more than a predetermined amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- When commanding the AIR system ON with a scan tool the PCM will activate the AIR pump and the AIR solenoid. The fuel control system will then enter a open loop status. This action will allow fresh air to enter the exhaust stream and allow the HO2S 1 mV parameters to drop to near 0 mV. This would indicate a properly operating system.

  However if the AIR pump does not operate or there is no airflow from the AIR pump entering the exhaust stream due to a leak in the AIR system, the HO2S 1 mV parameter may still decrease to 100 mV. This is due to fresh air being drawn into the exhaust stream from the exhaust check valve operation and the opening of the AIR shut-off valve. The HO2S 1 will respond with a decreasing mV parameter as a result of fresh air leaning out the exhaust gases. The HO2S 1 parameter voltages may decrease to nearly 100 mV but not approach the near 0 mV parameter.

- For any test that requires probing the PCM harness connector or probing a component harness connector, use the **J 35616** Connector Test Adapter Kit. Using this kit prevents damage to the component terminals and to the harness. Refer to **Using Connector Test Adapters** in Wiring Systems.

DTC P0410

AIR Pump Relay Underhood Electrical Center Terminal Identification			
Front of Vehicle			
Left Side of Vehicle	Ignition 1 voltage	Battery positive voltage	Right Side of Vehicle
	Pump Supply	Control	

- For an intermittent condition, refer to **Intermittent Conditions** .
- The vacuum lines at the AIR solenoid cannot be reversed, this condition may hold the shut-off valve open continually.
- Leaking exhaust check valves will leave traces of exhaust carbon and water laden exhaust gases in the AIR system and a possibility of heat damage to the AIR hoses and AIR shut-off valve.
- An intermittent may be caused by any of the following conditions:
  - Low system air flow
  - Excessive exhaust system back pressure
  - Moisture, water or debris ingested into the AIR pump
  - Pinched, kinked, heat damaged, or deteriorated hoses or vacuum hoses.
  - Restrictions in the pump inlet, duct, or filter

Test Description

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

14: This step determines if excessive resistance on the AIR pump supply circuit is the cause for an inoperative AIR pump. Two ohms of resistance on this circuit can prevent the AIR pump from running.

15: This step determines if excessive resistance on the AIR pump ground circuit is the cause for an inoperative AIR pump. Two ohms of resistance on this circuit can prevent the AIR pump from running.

18: This step determines if the AIR system is operating normally.

DTC P0410

Step -	Action	values	Yes	No
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0412 or DTC P0418 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Command the secondary air injection (AIR) pump relay ON and OFF with a scan tool. 3. Listen for AIR pump operation. Does the AIR pump turn ON and OFF with each command of the scan tool?	-	Go to **Step 18**	Go to **Step 4**
4	Inspect the AIR pump fuse. Is the AIR pump fuse open?	-	Go to **Step 5**	Go to **Step 9**
5	1. Turn OFF the ignition. 2. Disconnect the AIR pump connector. 3. Connect a test lamp between the AIR pump supply voltage circuit and the ground circuit of the AIR pump at the harness connector. 4. Replace the AIR pump fuse. 5. Command the AIR pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command of the scan tool?	-	Go to **Step 8**	Go to **Step 6**

6	Does the test lamp remain illuminated when the air pump relay is commanded ON and OFF with a scan tool?	-	Go to **Step 7**	Go to **Step 34**
7	1. Remove the AIR pump relay. 2. Turn ON the ignition, with the engine OFF. Does the test lamp remain illuminated?	-	Go to **Step 33**	Go to **Step 39**
8	1. Connect the AIR pump connector. 2. Replace the AIR pump fuse as necessary. 3. Command the AIR pump relay ON and OFF with a scan tool. 4. Listen for AIR pump operation. Does the AIR pump turn ON?	-	Go to **Intermittent Conditions**	Go to **Step 41**
9	1. Remove the AIR pump relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. 2. Inspect the AIR pump relay for an intermittent and for a poor connection at the AIR pump relay underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 42**	Go to **Step 10**
10	Connect a 30-amp**J 36169-A** Fused Jumper Wire between the battery positive circuit and the AIR pump supply voltage circuit at the AIR pump relay connector. Refer to **Using Fused Jumper Wires** in Wiring Systems. Does the AIR pump turn ON?	-	Go to **Step 16**	Go to **Step 11**
11	Test the battery positive voltage circuit between the AIR pump fuse and AIR pump relay for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 42**	Go to **Step 12**
12	1. Ensure the 30-amp **J 36169-A** is connected at the underhood fuse block. 2. Disconnect the AIR pump connector. 3. Probe the AIR pump supply voltage circuit at the AIR pump harness connector with a test lamp that is connected to a good ground.	-		

	Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?		Go to **Step 13**	Go to **Step 35**
13	Probe the ground circuit of the AIR pump harness connector with a test lamp that is connected to a battery voltage. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 14**	Go to **Step 36**
14	1. Connect a jumper wire between each of the terminals in the AIR pump harness connector and the corresponding terminal at the AIR pump. Refer to **Using Connector Test Adapters** in Wiring Systems. 2. Ensure the 30-amp **J 36169-A** is connected at the underhood fuse block. 3. Measure the voltage drop from the AIR pump supply voltage circuit at the AIR pump connector to the AIR pump supply voltage circuit at the AIR pump relay with a DMM. Refer to **Measuring Voltage Drop** and **Circuit Testing** in Wiring Systems. Is the voltage drop less than the specified value?	0.6 V	Go to **Step 15**	Go to **Step 35**
15	Measure the voltage drop from the AIR pump ground circuit at the AIR pump harness connector to a good ground with a DMM. Refer to **Circuit Testing** and **Measuring Voltage Drop** in Wiring Systems. Is the voltage drop less than the specified value?	0.6 V	Go to **Step 17**	Go to **Step 36**
16	Measure the resistance of the AIR pump relay control circuit between the powertrain control module (PCM) and the AIR pump relay with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	15 ohm	Go to **Step 17**	Go to **Step 37**
17	**IMPORTANT:** **The DMM and test leads must be calibrated to 0 ohms in order to prevent misdiagnosis. Refer to the DMM User Manual for calibration procedure.** 1. With the AIR pump relay removed from the vehicle, energize the relay with a 12-volt power and ground source. 2. Measure the resistance at the relay switch circuit with a DMM.	1-3 ohm		

	Is the resistance within the specified range?		Go to **Step 27**	Go to **Step 39**
18	1. Start and idle the engine. 2. Monitor the HO2S bank 1 sensor 1 and bank 2 sensor 1 voltage parameters. 3. Command the AIR pump system ON with a scan tool. Do both of the HO2S voltage parameters decrease to the specified value within 20 seconds?	75 mV	Go to Diagnostic Aids	Go to **Step 19**
19	1. Turn OFF the ignition. 2. Disconnect the AIR shut-off valve outlet hose at the in-line connector beside the generator. 3. Turn ON the ignition, with the engine OFF. 4. Command the AIR pump relay ON with a scan tool. Is a pressurized airflow present at the AIR pump shut-off valve outlet hose?	-	Go to **Step 31**	Go to **Step 20**
20	1. Connect the AIR shut-off valve outlet hose at the in-line connector. 2. Disconnect the AIR shut-off valve from the AIR pump outlet hose. Refer to **Secondary Air Injection (AIR) Shut-Off Valve Replacement** . 3. Command the AIR pump relay ON with a scan tool. Is a pressurized airflow present at the AIR pump outlet hose?	-	Go to **Step 21**	Go to **Step 29**
21	1. Turn OFF the ignition. 2. Remove the vacuum hose from the AIR shut-off valve. 3. Connect a vacuum gage to the hose. 4. Start and idle the engine. 5. Command the AIR solenoid ON with a scan tool. Is the vacuum displayed on the gage above the specified value?	10 in Hg (254 mm)	Go to **Step 22**	Go to **Step 24**
	1. Turn OFF the ignition. 2. Connect a vacuum pump to the AIR shut-off			

22	valve. 3. Apply 10 inches Hg (254 mm) of vacuum to the AIR shut-off valve. Does the AIR shut-off valve hold vacuum for the specified amount of time?	30 seconds	Go to **Step 23**	Go to **Step 38**
23	Inspect for a restriction or for a blockage in the AIR shut-off valve. Did you find and correct the condition?	-	Go to **Step 43**	Go to **Step 30**
24	1. Turn OFF the ignition. 2. Disconnect the vacuum supply hose from the inlet of the AIR solenoid. Refer to **Secondary Air Injection (AIR) Vacuum Control Solenoid Valve Replacement** . 3. Install a vacuum gage to the hose. 4. Start and idle the engine. Is the vacuum displayed on the gage above the specified amount?	10 in Hg (254 mm)	Go to **Step 25**	Go to **Step 32**
25	Measure the resistance of the AIR solenoid control circuit between the PCM and the AIR solenoid with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	15 ohm	Go to **Step 26**	Go to **Step 37**
26	Measure the resistance of the AIR solenoid ignition 1 voltage circuit between the ENG IGN 1 fuse and the AIR solenoid with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	15 ohm	Go to **Step 28**	Go to **Step 37**
27	Test for an intermittent and for a poor connection at the AIR pump. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 42**	Go to **Step 41**
28	Inspect the vacuum hose between the AIR shut-off valve and AIR solenoid for a leak or restriction. Did you find and correct a condition?	-	Go to **Step 43**	Go to **Step 40**
29	Inspect for a restriction in one of the following components: • The AIR pump inlet hose • The AIR pump outlet hose-Refer to **Secondary Air Injection (AIR) Shut-Off Valve Replacement** .	-		

	Did you find and correct a condition?		Go to **Step 43**	Go to **Step 41**
30	Repair the restriction or leak in the AIR shut-off valve outlet hose between the AIR shut-off valve and the crossover pipe. Did you complete the repair?	-	Go to **Step 43**	-
31	**CAUTION:** **Refer to Hot Exhaust System Caution in Cautions and Notices.** Repair the restriction in one of the following components: • The AIR shut-off valve outlet hose between the in-line connector and the crossover pipe. • The crossover pipe • Both exhaust check valves-Refer to **Secondary Air Injection (AIR) Check Valve/Pipe Replacement - Bank 1** and **Secondary Air Injection (AIR) Check Valve/Pipe Replacement - Bank 2** . • Both exhaust check valve outlet pipes Did you complete the repair?	-	Go to **Step 43**	-
32	Repair the restriction or leak in one of the following components: • The vacuum hose, from the intake manifold to the AIR solenoid • The vacuum check valve • The intake manifold vacuum port Did you complete the repair?	-	Go to **Step 43**	-
33	1. Repair the short to voltage in the AIR pump supply voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. 2. Replace the AIR pump fuse as necessary. Did you complete the repair?	-	Go to **Step 42**	-
34	1. Repair the short to ground in the AIR pump supply voltage circuit. Refer to **Wiring Repairs** in Wiring Systems.	-		

	2. Replace the AIR pump fuse as necessary. Did you complete the repair?		Go to **Step 43**	-
35	Repair the open or high resistance in the AIR pump supply voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 43**	-
36	Repair the open or high resistance in the AIR pump ground circuit. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 43**	-
37	Repair the circuit with the high resistance. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 43**	-
38	Replace the AIR shut-off valve. Refer to **Secondary Air Injection (AIR) Shut-Off Valve Replacement** . Did you complete the replacement?	-	Go to **Step 43**	-
39	Replace the AIR pump relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	-	Go to **Step 42**	-
40	Replace the AIR Solenoid. Refer to **Secondary Air Injection (AIR) Vacuum Control Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 43**	-
41	1. Replace the AIR pump. Refer to **Secondary Air Injection (AIR) Pump Replacement** . 2. Replace the AIR pump fuse as necessary. Did you complete the replacement?	-	Go to **Step 42**	-
42	1. Ensure all components are installed and secured. 2. Ensure the AIR pump is connected. 3. Command the AIR pump relay ON and OFF with a scan tool. Does the AIR pump relay turn ON and OFF when commanded with a scan tool?	-	Go to **Step 43**	Go to **Step 2**
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

43	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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 44**	
44	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK	

DTC P0412

Circuit Description

Voltage is supplied to the secondary air injection (AIR) solenoid by the ignition 1 voltage circuit. The powertrain control module (PCM) supplies the ground path to the solenoid by an internal integrated circuit called an output driver module (ODM). One of the ODM output circuits is configured to operate as a low side driver for the solenoid. The low side driver also incorporates a fault detection circuit, which is continuously monitored by the PCM. When the PCM completes the ground circuit to the solenoid, engine vacuum is applied to the AIR shut-off valve. If the PCM detects a low voltage on the control circuit when the solenoid is commanded OFF, or a high voltage when the solenoid is commanded ON, DTC P0412 sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions exist for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

5: This step tests for voltage to the AIR solenoid.

6: This step verifies that the PCM is providing ground to the AIR solenoid.

7: This step tests if a ground is constantly being applied to the AIR solenoid.

DTC P0412

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the ENG IGN 1 fuse. Is the ENG IGN 1 fuse open?	Go to **Step 12**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Command the secondary air injection (AIR) solenoid ON and OFF with a scan tool. 3. Listen for a click at the rear of the right front fender when the AIR solenoid operates. Repeat commands as necessary. Does the AIR solenoid click ON and OFF when commanded with a scan tool?	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 1 minute. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 5**	Go to **Intermittent Conditions**
	1. Turn OFF the ignition.		

5	2. Disconnect the AIR solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit at the AIR solenoid connector with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 13**
6	1. Connect a test lamp between the AIR solenoid control circuit and the ignition 1 voltage circuit at the AIR solenoid connector. 2. Command the AIR solenoid ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	Go to **Step 10**	Go to **Step 7**
7	Does the test lamp remain illuminated with each command of the scan tool?	Go to **Step 9**	Go to **Step 8**
8	Test the AIR solenoid control circuit for an open or short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 11**
9	Test the AIR solenoid control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
10	Test for an intermittent and for a poor connection at the AIR solenoid. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 14**
11	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
12	**IMPORTANT:** **The ignition 1 voltage circuit of the AIR solenoid is spiced to other components of the vehicle.** Test all circuits and components that are supplied by the ENG IGN 1 fuse for excessive current draw. Refer to **Circuit Testing** and **Wiring Repairs** in		Go to **Testing for Intermittent Conditions**

	Wiring Systems.Did you find and correct the condition?	Go to **Step 16**	**and Poor Connections** in Wiring Systems
13	Repair the open in the ignition 1 voltage circuit. Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	-
14	Replace the AIR solenoid. Refer to **Secondary Air Injection (AIR) Vacuum Control Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 16**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 16**	-
16	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 17**
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0418

Circuit Description

The secondary air injection (AIR) pump relay controls the high current flow to the AIR pump. Ignition voltage is supplied to the AIR pump relay coil when the ignition is ON. Battery positive voltage is supplied to the armature contacts at all times. The powertrain control module (PCM) controls the relay by supplying a ground path to the relay coil control circuit by an internal integrated circuit called an output driver module (ODM). The low side driver also incorporates a fault detection circuit that is continuously monitored by the PCM. The voltage on the control circuit should be battery voltage when the ignition is ON and the AIR pump relay is at rest. If the fault detection circuit measures a low voltage under this condition it is an indication of an open or short to ground on the control or ignition 1 circuits. An open AIR pump relay coil fault may also be present. If the PCM detects low voltage on the AIR pump relay control circuit when the AIR pump relay is commanded OFF or a high voltage when the AIR pump relay is commanded ON, DTC P0418 sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- All the above conditions exist for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

DTC P0418

AIR Pump Relay Terminal Identification			
Front of Vehicle			
Left Side of Vehicle	Ignition	B+	Right Side of Vehicle
	Pump Supply	Control	

Test Description

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

5: This step tests for voltage at the coil side of the relay.

6: This step verifies that the PCM is providing ground to the AIR pump relay.

8: This step tests if a ground is constantly being applied to the AIR pump relay.

DTC P0418

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics			

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the ENG IGN 1 fuse. Is the ENG IGN 1 fuse open?	Go to **Step 13**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Command the secondary air injection (AIR) pump relay ON and OFF with a scan tool. 3. Listen for a click when the relay operates. Repeat the commands as necessary. Does the AIR pump relay turn ON and OFF with each command?	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Remove the AIR pump relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit at the AIR pump relay connector with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 12**
6	1. Connect a test lamp between the control circuit of the AIR pump relay and the ignition 1 voltage circuit of the AIR pump relay connector. 2. Command the AIR pump relay ON and OFF with a scan tool. Refer to Diagnostic Aids for terminal identification. Does the test lamp turn ON and OFF when commanded		

	with a scan tool?	Go to **Step 10**	Go to **Step 7**
7	Did the test lamp remain illuminated when the scan tool was commanded ON and OFF?	Go to **Step 9**	Go to **Step 8**
8	**IMPORTANT:** **The AIR pump may be damaged if the control circuit is shorted to voltage.** Test the AIR pump relay control circuit for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
9	**IMPORTANT:** **The AIR pump may be damage if the control circuit is shorted to ground.** Test the AIR pump relay control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 14**	Go to **Step 17**
10	Test for an intermittent and for a poor connection at the AIR pump relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 16**
11	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
12	Repair the open circuit in the ignition 1 voltage circuit of the AIR pump relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 18**	-
13	**IMPORTANT:** **The ignition 1 voltage circuit of the AIR pump relay is spiced to other components of the vehicle.** Test all circuits and components that are supplied by the ENG IGN 1 fuse for excessive current draw. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 18**	-
14	1. Ensure all components are installed and all connections are secured. 2. Command the AIR pump relay ON and OFF with a scan tool.		

	Does the AIR pump turn ON and OFF when commanded with a scan tool?	Go to **Step 18**	Go to **Step 15**
15	1. Replace the AIR pump. Refer to **Secondary Air Injection (AIR) Pump Replacement** . 2. Replace the AIR pump fuse as necessary. Did you complete the replacement?	Go to **Step 18**	-
16	Replace the AIR pump relay. Did you complete the replacement?	Go to **Step 18**	-
17	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 18**	-
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. 5. This DTC will not report a pass. The scan tool status for this DTC will not report a pass. The scan tool will only display if the diagnostic test fails. The repair is not complete if the scan tool indicates that the diagnostic test ran and failed. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0420 OR P0430

Circuit Description

The three-way catalytic converter (TWC) reduces emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converter promotes a chemical reaction, which oxidizes the HC and CO that are present in the exhaust gas. This process converts these chemicals into water vapor and carbon dioxide (CO2), and will reduce the NOx, by converting them into nitrogen. The catalytic converter also stores oxygen. The powertrain control module (PCM) monitors this process using heated oxygen sensor (HO2S) bank 1 sensor 2 and HO2S bank 2 sensor 2, located in the exhaust stream after the TWC. These sensors are referred to as the catalyst monitor sensors. The catalyst monitor sensors produce an output signal that the PCM uses to indicate the oxygen storage capacity of the catalyst. This determines the catalyst's ability to effectively convert the exhaust emissions.

If the catalyst is functioning correctly, the HO2S bank 1 sensor 2 and the HO2S bank 2 sensor 2 signals will be far less active than the signals that are produced by the HO2S bank 1 sensor 1 and the HO2S bank 2 sensor 1. This indicates that the TWC oxygen storage capacity is at an acceptable threshold. When the response time of the catalyst monitor sensors are close to that of the fuel control sensors, the ability of the catalyst to store oxygen may be below an acceptable threshold.

The PCM performs this diagnostic test at idle. When the conditions for running this DTC are met, the following occurs:

- The air-to-fuel ratio transitions from lean to rich.
- The air-to-fuel ratio transitions a second time rich to lean, opposite the first air-to-fuel ratio transition.
- The PCM captures the response time of the front and the rear HO2S when the air-to-fuel ratio transitions occur. The HO2S response time changes from less than 350 mV to more than 600 mV, and from more than 600 mV to less than 350 mV.
- The PCM measures the time necessary for the rear HO2S voltage to cross a reference lean-to-rich threshold, and the time necessary for the front HO2S voltage to cross the same lean-to-rich threshold. The difference between the front HO2S time and the rear HO2S time indicates the oxygen storage capacity of the catalyst. If the PCM detects that this time difference is less than a predetermined value, DTC P0420 for bank 1 or DTC P0430 for bank 2 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0125, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0325, P0327, P0336, P0341, P0342, P0343, P0351-P0358, P0410, P0442, P0443, P0446, P0449, P0455, P0491, P0492, P0496, P0502, P0503, P0506, P0507, P1133, P1134, P1153, P1154, P1516, P1518, P2108, P2121, P2125, P2126, P2130, P2131, P2135 are not set.
- The engine has been running for more than 10 minutes.
- The intake air temperature (IAT) is between -7 and +85°C (+20 and +185°F).
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The engine coolant temperature (ECT) is between 70-120°C (158-248°F).
- Since the end of the last idle period, the engine speed has been more than 900 RPM for 42 seconds.
- The Closed Loop fuel control is enabled.
- The engine must be at a stable idle speed, within 200 RPM of desired idle.
- The battery voltage is more than 10.7 volts.

Conditions for Setting the DTC

The PCM determines that the oxygen storage capability of the TWC has degraded to less than a calibrated threshold.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- These conditions may cause a catalytic converter to degrade. Inspect for the following conditions:
  - An engine misfire
  - High engine oil or high coolant consumption
  - Retarded spark timing
  - A weak or poor spark
  - A lean fuel mixture
  - A rich fuel mixture
  - A damaged oxygen sensor or wiring harness
- If an intermittent condition cannot be duplicated, the information included in Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was set.
- The catalyst may have been temporarily contaminated with a chemical from a fuel additive, fuel contamination or any of the above conditions.
- If the condition is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

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

5: This step indicates that a catalytic converter which has been discolored may be due to an engine running rich, lean or had a previous misfire. Verifying the fuel trim percentages may be of assistance in determining if such a condition exists.

6: This step inspects for conditions that can cause the three-way catalytic converter efficiency to appear degraded.

DTC P0420 or P0430

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	Review the DTC information on the scan tool. Are any other DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Start and idle the engine until Closed Loop is achieved. 2. Increase the engine speed to 1,500 RPM for 1 minute. 3. Return the engine to a stabilized idle. 4. Observe the catalyst monitor HO2S 2 voltage parameter on the scan tool for the applicable bank. Is the HO2S 2 voltage parameter transitioning below the first specified value and above the second specified value?	350 mV 600 mV	Go to **Step 5**	Go to **Step 4**
4	1. Clear the DTCs with a scan tool. 2. Start the engine. 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. Did DTC P0420 or DTC P0430 set?	-	Go to **Step 5**	Go to Diagnostic Aids
5	**IMPORTANT:** **Verify that the three-way catalytic converter is a high quality part that meets the OEM specifications.** Visually and physically inspect the three-way catalytic convertor for the following conditions: • Dents • Severe discoloration caused by excessive temperatures • Internal rattles caused by loose catalyst substrate • Restrictions-Refer to **Restricted Exhaust** in Engine Exhaust. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 6**
	Visually inspect the exhaust system for the following conditions:			

6	• The Exhaust System for leaks-Refer to **Exhaust Leakage** in Engine Exhaust. • Physical damage • Loose or missing hardware • The heated oxygen sensor (HO2S) 2 for the applicable bank for proper torque Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
7	Visually inspect the HO2S 2 at the applicable bank for the following conditions: • The pigtail and wiring harness contacting the exhaust or any ground. • Road Damage Did you find a condition?	-	Go to **Step 8**	Go to **Step 9**
8	Replace the applicable HO2S 2 sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 10**	-
9	**NOTE:** **In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.** Replace the three-way catalytic converter. Refer to **Catalytic Converter Replacement** in Engine Exhaust.Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?		Go to **Diagnostic Trouble Code**	

		-	**(DTC) List**	System OK

DTC P0442

System Description

This diagnostic tests the Evaporative Emission (EVAP) System for a small leak when the key is turned OFF and the correct conditions are met.

Heat is transferred into a vehicle fuel tank while the vehicle is operating. When the vehicle is turned OFF, a change in the fuel tank vapor temperature occurs, which results in corresponding pressure changes in the fuel tank vapor space. This change is monitored by the control module using the fuel tank pressure sensor input. The control module then makes a judgement on the integrity of the system. With a 0.51 mm (0.020 inches) leak in the system, the amount of pressure change observed is significantly less than that of a sealed system.

If the control module detects a pressure change less than a calibrated amount, DTC P0442 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0125, P0335, P0336, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0500, P0502, P0503, P1683 are not set.
- The diagnostic runs once with a 10 hour minimum between tests after a fail.
- DTC P0455 must run and pass.
- The start up intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start up engine coolant temperature (ECT) is less than 30°C (86°F).
- The start up IAT and ECT are within 8°C (15°F).
- The barometric pressure (BARO) is more than 74 kPa.
- The ambient air temperature is between 2-32°C (36-90°F).
- The engine run time minimum is 10 minutes.
- The odometer displays more than 10 miles.
- The vehicle has traveled more than 3 miles this trip.
- The ECT is more than 70°C (158°F).
- The fuel level is between 15-85 percent.
- The ignition is OFF.

Conditions for Setting the DTC

The control module detects a pressure change that is less than a calibrated amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module

stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- To help locate intermittent leaks, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **J 41413-SPT** .
- For intermittent conditions, refer to **Intermittent Conditions** .

Test Description

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

3: Introducing smoke in 15 second intervals may allow smaller leak areas to be more noticeable. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.

5: This step verifies that repairs are complete and that no other condition is present.

DTC P0442

Step	Action	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Inspect the evaporative emission (EVAP) system for the following conditions: • Loose, missing, or damaged service port dust cap and/or schrader valve • Loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP canister purge solenoid valve 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information.		

	3. Inspect the EVAP system for the following conditions: • Disconnected, improperly routed, kinked, or damaged EVAP pipes and hose • A damaged EVAP canister vent solenoid valve or EVAP canister Did you find and correct the condition?	Go to **Step 5**	Go to **Step 3**
3	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 3. Install the **J 41415-40** Fuel Tank Cap Adapter or GE-41415-50 Interrupted Thread Fuel Tank Cap Adapter to the fuel fill pipe. 4. Connect the **J 41413-200** nitrogen/smoke supply hose to the **J 41415-40** or GE-41415-50 . 5. Turn ON the ignition, with the engine OFF. 6. Command the EVAP canister vent solenoid valve closed with a scan tool. 7. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 8. Use the remote switch to introduce smoke into the EVAP system. 9. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 10. Remove the **J 41413-VLV** once smoke is observed. 11. Continue to introduce smoke into the EVAP system for an additional 60 seconds. 12. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 13. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to **Step 5**	Go to **Step 4**
	1. Disconnect the **J 41415-40** or GE-41415-50 from the fuel fill pipe.		

4	2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** . 6. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to **Step 5**	Go to Diagnostic Aids
5	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** . 3. Use the remote switch to activate the **J 41413-200** . 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** . 5. Install the **J 41415-40** or GE-41415-50 to the fuel fill pipe. 6. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the **J 41415-40** or GE-41415-50 . 7. Turn ON the ignition, with the engine OFF. 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 10. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to **Step 6**	Go to **Step 2**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0443

Circuit Description

An ignition voltage is supplied directly to the evaporative emission (EVAP) canister purge solenoid valve. The EVAP canister purge solenoid valve is pulse width modulated (PWM). The scan tool displays the amount of ON time as a percentage. The control module monitors the status of the driver. The control module controls the EVAP canister purge solenoid valve ON time by grounding the control circuit via an internal switch called a driver. If the control module detects an incorrect voltage for the commanded state of the driver, this DTC sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The control module detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: This step tests if the concern is active. The EVAP canister purge solenoid valve is pulse width modulated (PWM). A clicking should be heard or felt when the EVAP canister purge solenoid valve is commanded to 50 percent and should stop when the EVAP canister purge solenoid valve is commanded to 0 percent. The rate at which the EVAP canister purge solenoid valve cycles should increase as the

commanded state is increased and decrease as the commanded state is decreased. Repeat the commands as necessary.

5: This step tests if a ground is constantly being applied to the EVAP canister purge solenoid valve.

6: This step verifies that the control module is providing ground to the EVAP canister purge solenoid valve.

DTC P0443

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister purge solenoid valve to 50 percent and then to 0 percent with a scan tool. Do you hear or feel a clicking from the EVAP canister purge solenoid valve when it is commanded to 50 percent?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/ Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP canister purge solenoid valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the EVAP canister purge solenoid valve with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
	1. Connect a test lamp between the control circuit of the EVAP canister purge solenoid valve and the		

5	ignition 1 voltage circuit of the EVAP canister purge solenoid valve. 2. Command the EVAP canister purge solenoid valve to 0 percent with a scan tool. Does the test lamp illuminated?	Go to **Step 8**	Go to **Step 6**
6	Command the EVAP canister purge solenoid valve to 50 percent with a scan tool. Does the test lamp illuminate or pulse when the EVAP canister purge solenoid valve is commanded to 50 percent?	Go to **Step 9**	Go to **Step 7**
7	Test the control circuit of the EVAP canister purge solenoid valve for an open or short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the EVAP canister purge solenoid valve for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Test for an intermittent and for a poor connection at the EVAP canister purge solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Repair the open or short to ground in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Replace the fuse if necessary. Did you complete the repair?	Go to **Step 14**	-
12	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0446

System Description

This DTC tests the Evaporative Emission (EVAP) System for a restricted or blocked EVAP canister vent path. The control module commands the EVAP canister purge solenoid valve Open and the EVAP canister vent solenoid valve Closed. This allows vacuum to be applied to the EVAP system. Once a calibrated vacuum level has been reached, the control module commands the EVAP canister purge solenoid valve Closed and the EVAP canister vent solenoid valve Open. The control module monitors the fuel tank pressure (FTP) sensor for a decrease in vacuum. If the vacuum does not decrease to near 0 inches H2O in a calibrated 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 canister purge and vent solenoid valves.

DTC P0446

Control Module Command	EVAP Canister Purge Solenoid Valve	EVAP Canister Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0125, P0442, P0443, P0449, P0452, P0453, P0455, P0502, P0503, P1112, P1114, P1115, P1120, P1133, P1134, P1153, P1154, P1220, P1221 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start up ECT and IAT are within 9°C (16°F) of each other.

Conditions for Setting the DTC

- The FTP sensor is less than -10 inches H2O.

- The condition is present for more than 30 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- An intermittent condition could be caused by a damaged EVAP vent housing, a temporary blockage at the EVAP canister vent solenoid valve inlet, or a pinched vent hose. A blockage in the Vent System will also cause a poor fuel fill problem.
- For intermittent conditions, refer to **Intermittent Conditions**

DTC P0446

Step -	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the Evaporative Emission (EVAP) System for the following conditions: • A damaged EVAP canister vent solenoid valve-Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . • A pinched EVAP canister vent hose • A damaged EVAP canister-Refer to	-		

	Evaporative Emission (EVAP) Canister Replacement . Did you find and correct the condition?		Go to **Step 15**		Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the purge line from the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . 3. Turn ON the ignition, with the engine OFF. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 4**	Go to **Step 9**	
4	**IMPORTANT:** **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Connect the EVAP canister purge pipe. 3. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 4. Install the **J 41415-40** Fuel Tank Cap Adapter or GE-41415-50 Interrupted Thread Fuel Tank Cap Adapter to the fuel fill pipe. 5. Connect the fuel fill cap to the **J 41415-40** or GE-41415-50 . 6. Connect the **J 41413-200** nitrogen/smoke supply hose to the **J 41415-40** or GE-41415-50 . 7. Turn ON the ignition, with the engine OFF. 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 10. Use the remote switch to pressurize the	5 in H2O 1 in H2O			

	EVAP system to the first specified value. 11. Observe the fuel tank pressure sensor in H2O with a scan tool. 12. Command the EVAP canister vent solenoid valve open with a scan tool. Is the fuel tank pressure sensor parameter less than the second specified value?		Go to **Step 5**	Go to **Step 7**
5	1. Connect the nitrogen/smoke hose to the EVAP service port. 2. Remove the **J 41415-40** or GE-41415-50 . 3. Install the fuel fill cap to the fuel fill pipe. 4. Start the engine. 5. Allow the engine to idle. 6. Use the purge/seal function to seal the system with a scan tool. 7. Command the EVAP canister purge solenoid valve to 30 percent. 8. Observe the vacuum/pressure gage of the **J 41413-200** and the FTP parameter on the scan tool. 9. Allow the vacuum to increase on the gage of the **J 41413-200** , until it reaches approximately 16 inch H2O. 10. Use the purge/seal function to seal the system, with a scan tool. Is the FTP parameter on a scan tool within the specified value of the vacuum/pressure gage on the **J 41413-200** , until the vacuum reached the abort limit on a scan tool?	1 in H2O	Go to **Step 6**	Go to **Step 9**
6	Did the FTP parameter on a scan tool display more than the specified value?	3.2 V	Go to Diagnostic Aids	Go to **Step 9**
7	Disconnect the EVAP vent hose from the EVAP canister vent solenoid valve. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 13**	Go to **Step 8**
8	Disconnect the EVAP canister vent hose from the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 11**	Go to **Step 14**

9	Test the low reference circuit of the fuel tank pressure (FTP) sensor for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
10	Test for poor connections at the harness connector of the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
11	Repair the pinched or restricted EVAP canister vent hose. Did you complete the repair?	-	Go to **Step 15**	-
12	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
13	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Turn OFF the ignition. 2. Disconnect the purge line from the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . 3. Turn ON the ignition, with the engine OFF. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 16**	Go to **Step 2**
	IMPORTANT: **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Reconnect all disconnected components. 3. Connect the **J 41413-200** to the fuel fill pipe.			

16	4. Turn ON the ignition, with the engine OFF 5. Command the EVAP canister vent solenoid valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 7. Use the remote switch to pressurize the EVAP system to the first specified value. 8. Observe the fuel tank pressure sensor in H2O with a scan tool. 9. Command the EVAP canister vent solenoid valve open with a scan tool. Is the fuel tank pressure sensor parameter less than the second specified value?	5 in H2O 1 in H2O	Go to **Step 17**	Go to **Step 2**	
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK	

DTC P0449

Circuit Description

An ignition voltage is supplied to the evaporative emission (EVAP) canister vent solenoid valve. The control module grounds the EVAP canister vent solenoid valve control circuit to close the valve by means of an internal switch called a driver. The scan tool displays the commanded state of the EVAP canister vent solenoid valve as ON or OFF. The control module monitors the status of the driver. If the control module detects an incorrect voltage for the commanded state of the driver, this DTC sets.

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

DTC P0449

Control Module Command	EVAP Canister Vent Valve Position
ON	CLOSED
OFF	OPEN

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The control module detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: A click should be heard or felt when the EVAP canister vent solenoid valve operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.

5: This step verifies that the control module is providing ground to the EVAP canister vent solenoid valve.

6: This step tests if the EVAP canister vent solenoid valve control circuit is grounded.

DTC P0449

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister vent solenoid valve ON and OFF with a scan tool.		

	Do you hear or feel a click from the EVAP canister vent solenoid valve when it is commanded ON and OFF?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP canister vent solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the EVAP canister vent solenoid valve with a test lamp that is connected to a good ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the EVAP canister vent solenoid valve and the ignition 1 voltage circuit of the EVAP canister vent solenoid valve. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. 2. Command the EVAP canister vent solenoid valve ON and OFF with a scan tool. Does the test lamp turn ON or OFF with each command?	Go to **Step 9**	Go to **Step 6**
6	Does the test lamp remain illuminated with each command?	Go to **Step 8**	Go to **Step 7**
7	Test the control circuit for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit for a short to ground. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the EVAP canister vent solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and		

	Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	1. Repair the open or short to ground in the ignition 1 voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the fuse if necessary. Did you complete the repair?	Go to **Step 14**	-
12	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0452

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage goes below a calibrated value, this DTC sets.

The following table illustrates the relationship between the FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0452

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

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The fuel tank pressure (FTP) sensor voltage is less than 0.1 volts
- All conditions present for more than 5 seconds

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

5: Tests for the proper operation of the circuit in the high voltage range.

DTC P0452

Step	Action	Value (s)	Yes	No

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

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble codes (DTC) information using the scan tool Did DTC P1639 fail this ignition?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Observe the Fuel Tank Pressure sensor parameter with a scan tool. Is the Fuel Tank Pressure sensor parameter less than the specified value?	0.1 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the FTP sensor harness connector. 3. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the FTP sensor and the signal circuit of the FTP sensor. 4. Turn ON the ignition, with the engine OFF. 5. Observe the FTP voltage with a scan tool. Is the Fuel Tank Pressure sensor parameter within the specified value?	4.9-5.1 V	Go to **Step 8**	Go to **Step 6**
6	Test the 5-volt reference circuit for an open circuit or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
	Test the signal circuit for the following conditions:			

7	• A short to ground • An open • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for an intermittent and for a poor connection at the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0453

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt

reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage increases above a calibrated value, this DTC sets.

The following table illustrates the relationship between FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0453

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

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The fuel tank pressure (FTP) sensor voltage is more than 4.9 volts.
- All conditions present for more than 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If DTC P1639 is set, the 5-volt reference circuit may be shorted to a voltage.

DTC P0453

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Idle the engine for 1 minute. 2. Monitor the Diagnostic Trouble Code (DTC) Information using the scan tool. Did DTC P1639 fail this ignition?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Fuel Tank Pressure sensor parameter with a scan tool. Is the Fuel Tank Pressure sensor parameter more than the specified value?	4.3 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame / Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the FTP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Tank Pressure sensor parameter with a scan tool. Does the scan tool indicate that the FTP sensor voltage is more than the specified value?	4.3 V	Go to **Step 6**	Go to **Step 7**
6	Test the signal circuit for a short to voltage. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 13**	Go to **Step 10**
7	Probe the low reference circuit of the FTP sensor with a test lamp that is connected to battery voltage. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Did the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 8**
8	Test the low reference circuit for an open. Refer to **Testing for Continuity** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0455

System Description

The control module tests the Evaporative Emission (EVAP) System for a large leak. The control module

monitors the fuel tank pressure (FTP) sensor signal to determine the EVAP system vacuum level. When the conditions for running are met, the control module commands the EVAP canister purge solenoid valve OPEN and the EVAP canister vent solenoid valve CLOSED. This allows engine vacuum to enter the EVAP system. At a calibrated time, or vacuum level, the control module commands the EVAP canister purge solenoid valve closed, sealing the system, and monitors the FTP sensor input in order to determine the EVAP system vacuum level. If the system is unable to achieve the calibrated vacuum level, or the vacuum level decreases too rapidly, this DTC sets.

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

DTC P0455

Control Module Command	EVAP Canister Purge Solenoid Valve	EVAP Canister Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0125, P0442, P0443, P0449, P0452, P0453, P1112, P1114, P1115, P1120, P1133, P1134, P1153, P1154, P1220, P1221 are not set.
- The engine is running.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start-up ECT and IAT are within 9°C (16°F) of each other.
- The vehicle speed sensor (VSS) is less than 121 km/h (75 mph).

Conditions For Setting the DTC

The EVAP system is not able to achieve or maintain vacuum during the diagnostic test.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- To help locate intermittent leaks, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light. Introducing smoke in 15 second intervals will allow less pressure into the EVAP System. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.
- A temporary blockage in the EVAP canister purge solenoid valve, purge pipe or EVAP canister could cause an intermittent condition. Inspect and repair any restriction in the EVAP system.
- To improve the visibility of the smoke exiting the EVAP System, observe the suspected leak area from different angles with the **J 41413-SPT** .
- Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.
- A condition may exist where a leak in the EVAP System only exists under a vacuum condition. By using the scan tool PURGE/SEAL function to create a vacuum, seal the system and observe the FTP parameter for vacuum decay, this type of leak may be detected.
- For intermittent conditions, refer to **Intermittent Conditions** .

Test Description

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

6: This step verifies proper operation of the FTP sensor.

7: A normal operating FTP sensor should increase above 5 inches of H2O and stop between 6 inches of H2O and 7 inches of H2O.

DTC P0455

Step	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	1. Inspect the Evaporative Emission (EVAP) System for the following conditions: • A loose, missing, or damaged service port schrader valve • A loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP canister purge solenoid valve 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Inspect the EVAP System for the following conditions: • Any disconnected, improperly routed, kinked, or damaged EVAP pipes and hoses • A damaged EVAP canister vent solenoid valve or EVAP canister Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 3**	
3	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 3. Turn the nitrogen/smoke valve to nitrogen. 4. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** . 5. Use the remote switch to activate the **J 41413-200** . 6. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** . 7. Install the **J 41415-40** Fuel Tank Cap Adapter or GE-41415-50 Interrupted Thread Fuel Tank Cap Adapter to the fuel fill pipe. 8. Install the fuel fill cap to the **J 41415-40** or GE-41415-50 .	-			

	9. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the **J 41415-40** or GE-41415-50 . 10. Turn ON the ignition, with the engine OFF. 11. Command the EVAP canister vent solenoid valve closed with a scan tool. 12. Use the remote switch to induce nitrogen and fill the EVAP System until the floating indicator stabilizes. 13. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?		Go to **Step 6**	Go to **Step 4**	
4	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** power supply clips to a known good 12-volt source. 3. Install the **J 41415-40** to the fuel fill pipe. 4. Connect the **J 41413-200** nitrogen/smoke supply hose and vehicle fuel fill cap to the **J 41415-40** or GE-41415-50 . 5. Turn ON the ignition, with the engine OFF. 6. Command the EVAP canister vent solenoid valve closed with a scan tool. 7. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 8. Use the remote switch to introduce smoke into the EVAP System. 9. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 10. Remove the **J 41413-VLV** once smoke is observed. 11. Continue to introduce smoke into the EVAP System for an additional 60 seconds. 12. Inspect the entire EVAP System for exiting smoke with the **J 41413-SPT** High Intensity White Light.	-			

	13. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?		Go to **Step 21**	Go to **Step 5**
5	1. Disconnect the **J 41415-40** or GE-41415-50 from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP System. 5. Inspect the entire EVAP System for exiting smoke with the **J 41413-SPT** . 6. Continue to introduce smoke at 15 second intervals until the leak source has been located Did you locate and repair a leak source?	-	Go to **Step 21**	Go to **Step 6**
6	1. Use the remote switch to stop introducing smoke. 2. Install the **J 41415-40** or GE-41415-50 to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose and vehicle fuel fill cap to the **J 41415-40** or GE-41415-50 . 4. Command the EVAP canister vent solenoid valve open with a scan tool. 5. Compare the fuel tank pressure sensor parameter with a scan tool to the**J 41413-200** pressure/vacuum gage. Is the scan tool fuel tank pressure sensor parameter within the specified value of the **J 41413-200** pressure/vacuum gage?	1 in H2O	Go to **Step 7**	Go to **Step 17**
7	1. Seal the EVAP System using the EVAP Purge/Seal function with a scan tool. 2. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 3. Use the **J 41413-200** to pressurize the EVAP System to the first specified value.	10 in H2O 5 in H2O		

	Is the fuel tank pressure sensor parameter more than the second specified value?		Go to **Step 8**	Go to **Step 17**
8	1. Use the remote switch to stop introducing nitrogen into the EVAP System. 2. Increase the EVAP canister purge solenoid valve to 100 percent. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 9**	Go to **Step 11**
9	1. Connect the nitrogen/smoke hose to the EVAP service port. 2. Remove the **J 41415-40** or GE-41415-50 . 3. Install the fuel fill cap to the fuel fill pipe. 4. Start the engine. 5. Allow the engine to idle. 6. Use the purge/seal function to seal the system with a scan tool. 7. Command the EVAP canister purge solenoid valve to 30 percent. 8. Observe the vacuum/pressure gage of the **J 41413-200** and the FTP parameter on the scan tool. 9. Allow the vacuum to increase on the gage of the **J 41413-200** , until it reaches approximately 16 inch H2O. 10. Use the purge/seal function to seal the system, with a scan tool. Is the FTP parameter on a scan tool within the specified value of the vacuum/pressure gage on the **J 41413-200** , until the vacuum reached the abort limit on a scan tool?	1 in H2O	Go to **Step 10**	Go to **Step 17**
10	Did the FTP parameter on a scan tool display more than the specified value?	3.2 V	Go to Diagnostic Aids	Go to **Step 17**
11	Disconnect the EVAP purge vacuum source from the EVAP canister purge solenoid valve. Is the Fuel Tank Pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 15**	Go to **Step 12**
12	Disconnect the EVAP canister purge pipe from the EVAP canister purge solenoid valve. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 18**	Go to **Step 13**

13	Disconnect the EVAP canister purge pipe at the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 19**	Go to **Step 14**
14	Disconnect the EVAP canister vapor pipe at the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 20**	Go to **Step 16**
15	Repair the pinched or obstructed EVAP canister solenoid valve vacuum source. Did you complete the repair?	-	Go to **Step 21**	-
16	Repair the pinched or obstructed EVAP canister vapor pipe. Did you complete the repair?	-	Go to **Step 21**	-
17	Replace the fuel tank pressure (FTP) sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
18	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Repair the restriction in the EVAP canister purge pipe. Refer to **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Vacuum Supply)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Engine Purge Pipe)** . Did you complete the repair?	-	Go to **Step 21**	-
20	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
21	**IMPORTANT:** **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Connect the **J 41413-200** to the fuel fill pipe. 2. Turn the nitrogen/smoke valve to NITROGEN. 3. Seal the EVAP System using the EVAP Purge/Seal function with a scan tool. 4. Pressurize the EVAP System to the specified value. 5. Observe the **J 41413-200** pressure/vacuum gage for 5 minutes.	5 in H2O		

	Does the **J 41413-200** pressure/vacuum gage remain constant?		Go to **Step 22**	Go to **Step 3**	
22	Observe the fuel tank pressure sensor parameter with a scan tool. Is the scan tool fuel tank pressure parameter within the specified value of the **J 41413-200** pressure/vacuum gage?	1 in H2O	Go to **Step 23**	Go to **Step 6**	
23	1. Observe the **J 41413-200** pressure/vacuum gage. 2. Increase the EVAP canister purge solenoid valve to 100 percent. Does the pressure decrease?	-	Go to **Step 24**		Go to **Step 12**
24	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK	