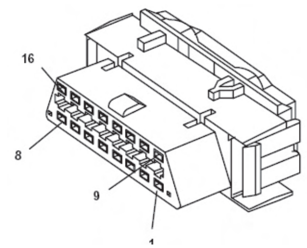
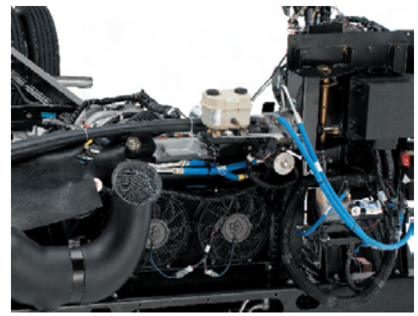
2007

ENGINE CONTROLS





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Application	Metric	English
Accelerator Pedal Bolt	9 N·m	80 lb in
Air Cleaner Outlet Duct Clamp	4 N·m	35 lb in
Auxiliary Heater Water Pump Bracket Bolt	15 N·m	11 lb ft
Camshaft Position (CMP) Sensor Bolt	29 N·m	21 lb ft
Canister Vent Solenoid (CVS) Bracket Bolt	12 N·m	106 lb in
Crankshaft Position (CKP) Sensor Bolt	25 N·m	18 lb ft
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Engine Wiring Harness Bracket Nut	5 N·m	44 lb in
EVAP Canister Bolt/Nut	25 N·m	18 lb ft
EVAP Canister Bracket Nut	25 N·m	18 lb ft
EVAP Canister Purge Solenoid Bolt	10.5 N·m	93 lb in
EVAP Vent Valve Bracket Bolt	12 N·m	106 lb in
Fuel Feed and EVAP Pipe Assembly Nut	12 N·m	106 lb in
Fuel Line Fitting	25 N·m	18 lb ft
Fuel Pipe Bracket Nut	10 N·m	89 lb in
Fuel Rail Bolts	10 N·m	89 lb in
Fuel Tank Strap Bolt	40 N·m	30 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Ignition Coil Bolt	8 N·m	71 lb in
Knock Sensor	20 N·m	15 lb ft
Mass Air Flow/Intake Air Temperature (MAF/IAT) Sensor Clamp	7 N·m	62 lb in
Powertrain Control Module (PCM) Electrical Connector Bolt	8 N·m	71 lb in
Spark Plug		
New Head	20 N·m	15 lb ft
Used Head	15 N·m	11 lb ft
Throttle Actuator Control (TAC) Module Nut	9 N·m	80 lb in
Throttle Body Nut	10 N·m	89 lb in

8.1L Engine Fastener Tightening Specifications

4.8/6.0L Engines		
	Specifications	
Application	Metric	English
Accelerator Pedal Bolt	9 N·m	80 lb in
Air Cleaner Outlet Duct Clamp	4 N·m	35 lb in
Camshaft Position (CMP) Sensor Bolt	12 N·m	106 lb in
Crankshaft Position (CKP) Sensor Bolt	12 N·m	106 lb in
Engine Coolant Temperature (ECT) Sensor	50 N·m	37 lb ft
Engine Wire Harness Bolt/Stud	10 N·m	89 lb in
EVAP Canister Nut	25 N·m	18 lb ft
EVAP Canister Bracket Nut	25 N·m	18 lb ft
EVAP Canister Purge Valve Bolt	10 N·m	89 lb in
Fuel Feed and EVAP Pipe Assembly Nut	12 N·m	106 lb in
Fuel Pipe Bracket Nut	10 N·m	89 lb in
Fuel Rail Stud	12 N·m	106 lb in
Fuel Tank Strap Bolt	40 N·m	30 lb ft
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4.8/6.0L Engines		
	Specifications	
Application	Metric	English
Mass Air Flow/Intake Air Temperature (MAF/IAT) Sensor Clamp	7 N·m	62 lb in
Powertrain Control Module (PCM) Electrical Connector Bolt	8 N·m	71 lb in
Spark Plug		
New Head	20 N·m	15 lb ft
Used Head	30 N·m	22 lb ft
Throttle Actuator Control (TAC) Module Nut	9 N·m	80 lb in
Throttle Body Nut	10 N·m	89 lb in

IGNITION SYSTEM SPECIFICATIONS

4.8/6.0L Ignition System Specifications

4.8/6.0L Ignition System Specifications		
	Specification	
Application	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	397-1,337 ohms	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	25171803 [AC plug type] 12567759 [NGK plug type]	

8.1L Ignition System Specifications

8.1L Ignition System Specifications		
	Specification	
Application	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	1,000 ohms per ft.	
Spark Plug Torque	20 N·m	15 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	TJ14R-P15 Denso plug type	

Altitude vs. Barometric Pressure

Altitude vs. Barometric Pressure		
Altitude Measured in Meters	**Altitude Measured in Feet**	**Barometric Pressure Measured in Kilopascals (kPa)**
Determine your altitude by contacting a local weather station or by using another reference source.		
4 267	14,000	56-64
3 962	13,000	58-66
3 658	12,000	61-69
3 353	11,000	64-72
3 048	10,000	66-74
2 743	9,000	69-77
2 438	8,000	71-79
2 134	7,000	74-82
1 829	6,000	77-85
1 524	5,000	80-88
1 219	4,000	83-91
914	3,000	87-95
610	2,000	90-98
305	1,000	94-102
0	0 Sea Level	96-104
-305	-1,000	101-105

Temperature vs. Resistance

Temperature vs. Resistance		
°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
150	302	47
140	284	60
130	266	77
120	248	100
110	230	132
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
–5	23	12300
–10	14	16180
–15	5	21450
–20	–4	28680
–30	–22	52700
–40	–40	100700

DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

Emissions Related DTCs

Action Taken When the DTC Sets - Type A

- 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.

Action Taken When the DTC Sets - Type B

- 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 - Type A or Type B

- The control module turns OFF the malfunction indicator lamp (MIL) after 4 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.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC - Type C

- 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 non-emission related diagnostic.
- Clear the DTC with a scan tool.

Conditions for Clearing the DTC - Type X

This DTC is available in the control module software, but has been disabled, or turned OFF. In this case, the diagnostic does not run, no DTCs are stored, and the MIL does not illuminate. Type X DTCs are used primarily for export vehicles that do not require MIL illumination or DTC storing.

DIAGNOSTIC TROUBLE CODE (DTC) TYPES

4.8/6.0L Engine Diagnostic Trouble Code (DTC) Types

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P0030	X
P0036	X
P0050	X
P0053	B
P0054	B
P0056	X
P0059	B
P0060	B
P0068	A
P0101	B
P0102	B
P0103	B
P0106	B
P0107	B
P0108	B
P0112	B
P0113	B
P0116	X
P0117	B
P0118	B
P0120	A
P0128	X
P0131	B
P0132	B
P0133	X

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P0134	B
P0135	X
P0137	B
P0138	B
P0140	B
P0141	X
P0151	B
P0152	B
P0153	X
P0154	B
P0155	X
P0157	B
P0158	B
P0160	B
P0161	X
P0171	B (No MIL)
P0172	B (No MIL)
P0174	B (No MIL)
P0175	B
P0200	B
P0218	C
P0220	A
P0230	B (No MIL)
P0300	B (No MIL)
P0315	A
P0325	B
P0327	B
P0332	B
P0335	B

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P0336	B
P0341	B
P0342	B
P0343	B
P0351	B
P0352	B
P0353	B
P0354	B
P0355	B
P0356	B
P0357	B
P0358	B
P0420	X
P0430	X
P0442	X
P0443	X
P0446	X
P0449	X
P0451	X
P0452	X
P0453	X
P0454	X
P0455	X
P0461	X
P0462	B (No MIL)
P0463	B (No MIL)
P0464	X
P0496	X
P0502	B

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P0503	B
P0506	B
P0507	B
P0522	C
P0523	C
P0530	C
P0562	C
P0563	C
P0567	C
P0568	C
P0601	A
P0602	A
P0604	A
P0606	A
P0608	C
P0609	C
P0622	C
P0641	B
P0650	B (No MIL)
P0651	B
P0654	C
P0706	C
P0711	C
P0712	C
P0713	C
P0716	B (No MIL)
P0717	B (No MIL)
P0719	C
P0724	C

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P0725	X
P0730	C
P0740	X
P0741	B
P0742	B
P0748	C
P0751	B (No MIL)
P0752	B
P0753	B
P0756	A (No MIL)
P0757	A (No MIL)
P0758	A (No MIL)
P0785	X
P0856	X
P0894	B
P1106	C
P1107	C
P1111	C
P1112	C
P1114	C
P1115	C
P1125	A
P1133	X
P1134	X
P1153	X
P1154	X
P1258	A
P1380	X
P1381	X

DTC Types - 4.8/6.0L Engine	
Diagnostic Trouble Code (DTC)	All Vehicles Over 8600 GVW
P1516	A
P1574	C
P1626	C
P1631	C
P1637	C
P1689	C
P1810	B
P2066	X
P2067	B (No MIL)
P2068	C
P2101	A
P2108	A
P2120	A
P2125	A
P2135	A
P2138	A
P2610	B
P2636	C
P2761	B
P2771	B (No MIL)
P2A01	X
P2A04	X
U0107	A

8.1L Engine Diagnostic Trouble Code (DTC) Types

DTC Types - 8.1L Engine		
Diagnostic Trouble Code (DTC)	Federal	California
P0030	X	B
P0036	X	B
P0050	X	B
P0053	X	B
P0054	X	B
P0056	X	B
P0059	X	B
P0060	X	B
P0068	A	A
P0101	B	B
P0102	B	B
P0103	B	B
P0106	B	B
P0107	B	B
P0108	B	B
P0112	B	B
P0113	B	B
P0116	X	B
P0117	B	B
P0118	B	B
P0120	A	A
P0128	X	B
P0131	B	B
P0132	B	B
P0133	X	B
P0134	B	B
P0135	X	B
P0137	X	B
P0138	X	B
P0140	X	B
P0141	X	B
P0151	B	B
P0152	B	B
P0153	X	B
P0154	B	B
P0155	X	B
P0157	X	B
P0158	X	B
P0160	X	B
P0161	X	B
P0171	B	B
P0172	B	B
P0174	B	B
P0175	B	B
P0200	B	B
P0220	A	A
P0230	B	B
P0300	B	B
P0315	A	A
P0325	B	B
P0327	B	B
P0332	B	B
P0335	B	B
P0336	B	B
P0341	B	B
P0342	B	B
P0343	B	B
P0351-P0358	B	B

DTC Types - 8.1L Engine		
Diagnostic Trouble Code (DTC)	Federal	California
P0420	X	A
P0430	X	A
P0442	X	A
P0443	B	B
P0446	X	B
P0449	X	B
P0451	X	A
P0452	X	B
P0453	X	B
P0454	X	A
P0455	X	B
P0461	X	B
P0462	B	B
P0463	B	B
P0464	X	A
P0496	X	B
P0500	B	B
P0506	B	B
P0507	B	B
P0522	C	C
P0523	C	C
P0530	C	C
P0562	C	C
P0563	C	C
P0567	C	C
P0568	C	C
P0571	C	C
P0601	A	A
P0602	A	A
P0604	A	A

DTC Types - 8.1L Engine		
Diagnostic Trouble Code (DTC)	Federal	California
P0606	A	A
P0608	C	C
P0609	C	C
P0622	C	C
P0641	B	B
P0650	B	B
P0651	B	B
P0654	C	C
P0700	A	A
P0706	C	C
P0802	B	B
P0833	B	B
P0856	B	B
P1125	A	A
P1133	X	B
P1134	X	B
P1153	X	B
P1154	X	B
P1258	A	A
P1380	X	C
P1381	X	C
P1516	A	A
P1574	C	C
P1626	C	C
P1631	C	C
P1637	C	C
P2067	B	X
P2068	B	X
P2101	A	A
P2108	A	A

DTC Types - 8.1L Engine		
Diagnostic Trouble Code (DTC)	Federal	California
P2120	A	A
P2125	A	A
P2135	A	A
P2138	A	A
P2610	B	B
P2636	C	C
P2A01	X	B
P2A04	X	B
U0107	A	A

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE DESCRIPTION

The powertrain has electronic controls to reduce exhaust emissions while maintaining excellent driveability and fuel economy. The powertrain control module (PCM) is the control center of this system. The PCM monitors numerous engine and vehicle functions. The PCM constantly looks at the information from various sensors and other inputs, and controls the systems that affect vehicle performance and emissions. The PCM also performs the diagnostic tests on various parts of the system. The PCM can recognize operational problems and alert the driver via the malfunction indicator lamp (MIL). When the PCM detects a malfunction, the PCM stores a diagnostic trouble code (DTC). The problem area is identified by the particular DTC that is set. The control module supplies a buffered voltage to various sensors and switches. Review the components and wiring diagrams in order to determine which systems are controlled by the PCM.

The following are some of the functions that the PCM controls:

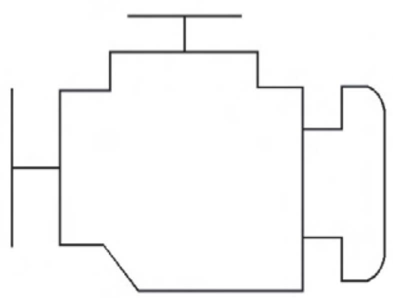
- The engine fueling
- The ignition control (IC)
- The knock sensor (KS) system
- The evaporative emissions (EVAP) system
- The secondary air injection (AIR) system (if equipped)
- The exhaust gas recirculation (EGR) system
- The automatic transmission functions
- The generator
- The A/C clutch control
- The cooling fan control

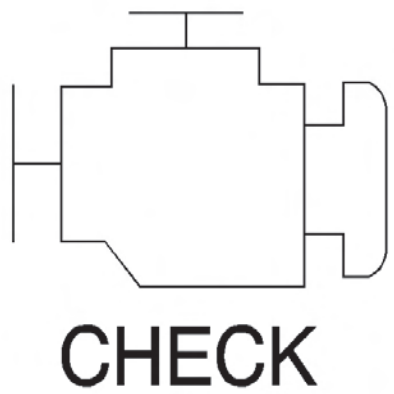
Powertrain Control Module Function

The powertrain control module (PCM) constantly looks at the information from various sensors and other inputs and controls systems that affect vehicle performance and emissions. The PCM also performs diagnostic tests on various parts of the system. The PCM can recognize operational problems and alert the driver via the malfunction indicator lamp (MIL). When the PCM detects a malfunction, the PCM stores a diagnostic trouble code (DTC). The problem area is identified by the particular DTC that is set. The control module supplies a buffered voltage to various sensors and switches. The input and output devices in the PCM include analog-to-digital converters, signal buffers, counters, and output drivers. The output drivers are electronic switches that complete a ground or voltage circuit when turned on. Most PCM controlled components are operated via output drivers. The PCM monitors these driver circuits for proper operation and, in most cases, can set a DTC corresponding to the controlled device if a problem is detected.

Malfunction Indicator Lamp (MIL) Operation

The malfunction indicator lamp (MIL) is located in the instrument panel cluster. The MIL will display as either SERVICE ENGINE SOON or one of the following symbols when commanded ON:





The MIL indicates that an emissions related fault has occurred and vehicle service is required.

The following is a list of the modes of operation for the MIL:

- The MIL illuminates when the ignition is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- The MIL turns OFF after the engine is started if a diagnostic fault is not present.
- The MIL remains illuminated after the engine is started if the control module detects a fault. A diagnostic trouble code (DTC) is stored any time the control module illuminates the MIL due to an emissions related fault. The MIL turns OFF after three consecutive ignition cycles in which a Test Passed has been reported for the diagnostic test that originally caused the MIL to illuminate.
- The MIL flashes if the control module detects a misfire condition which could damage the catalytic converter.
- When the MIL is illuminated and the engine stalls, the MIL will remain illuminated as long as the ignition is ON.
- When the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition is cycled OFF and then ON.

Trip

A trip is an interval of time during which the diagnostic test runs. A trip may consist of only a key cycle to power up the powertrain control module (PCM), allow the diagnostic to run, then cycle the key off to power down the PCM. A trip may also involve a PCM power up, meeting specific conditions to run the diagnostic test, then powering down the PCM. The definition of a trip depends upon the diagnostic. Some diagnostic tests run only once per trip (i.e., catalyst monitor) while other tests run continuously during each trip (i.e., misfire).

Warm-Up Cycle

The powertrain control module (PCM) uses warm-up cycles to run some diagnostics and to clear any diagnostic trouble codes (DTCs). A warm-up cycle occurs when the engine coolant temperature increases 22°C (40°F) from the start-up temperature. The engine coolant must also achieve a minimum temperature of 71°C (160°F). The PCM counts the number of warm-up cycles in order to clear the malfunction indicator lamp (MIL). The PCM will clear the DTCs when 40 consecutive warm-up cycles occur without a malfunction.

Diagnostic Trouble Codes (DTCs)

The powertrain control module (PCM) is programmed with test routines that test the operation of the various systems the PCM controls. Some tests monitor internal PCM functions. Many tests are run continuously. Other tests run only under specific conditions, referred to as Conditions for Running the DTC. When the vehicle is operating within the conditions for running a particular test, the PCM monitors certain parameters and determines if the values are within an expected range. The parameters and values considered outside the range of normal operation are listed as Conditions for Setting the DTC. When the Conditions for Setting the DTC occur, the PCM executes the Action Taken When the DTC Sets. Some DTCs alert the driver via the malfunction indicator lamp (MIL) or a message. Other DTCs do not trigger a driver warning, but are stored in memory. The PCM also saves data and input parameters when most DTCs are set. This data is stored in the Freeze Frame and/or Failure Records.

The DTCs are categorized by type. The DTC type is determined by the MIL operation and the manner in which the fault data is stored when a particular DTC fails. In some cases there may be exceptions to this structure. Therefore, when diagnosing the system it is important to read the Action Taken When the DTC Sets and the Conditions for Clearing the DTC in the supporting text.

There are different types of DTCs and different actions taken when the DTCs set. Refer to Diagnostic Trouble Code (DTC) Type Definitions for a description of the general characteristics of each DTC type.

DTC Status

When the scan tool displays a DTC, the status of the DTC is also displayed. The following DTC statuses are indicated only when they apply to the DTC that is set.

Fail This Ign. (Fail This Ignition): Indicates that this DTC failed during the present ignition cycle.

Last Test Fail: Indicates that this DTC failed the last time the test ran.

MIL Request: Indicates that this DTC is currently requesting the malfunction indicator lamp (MIL). This selection will report type B DTCs only when they have requested the MIL (failed twice).

Test Fail SCC (Test Failed Since Code Clear): Indicates that this DTC that has reported a failure since the last time DTCs were cleared.

History: Indicates that the DTC is stored in the powertrain control module (PCM) History memory. Type B DTCs will not appear in History until they have requested the MIL (failed twice). History will be displayed for all type A DTCs and type B DTCs (which have requested the MIL) that have failed within the last 40 warm-up cycles. Type C DTCs that have failed within the last 40 warm-up cycles will also appear in History.

Not Run SCC (Not Run Since Code Clear): DTCs will be listed in this category if the diagnostic has not run since DTCs were last cleared. This status is not included with the DTC display since the DTC can not be set if the diagnostic has not run. This information is displayed when DTC Info is requested using the scan tool.

THROTTLE ACTUATOR CONTROL (TAC) SYSTEM DESCRIPTION

The throttle actuator control (TAC) system delivers improved throttle response and greater reliability and eliminates the need for mechanical cable. The TAC system performs the following functions:

- Accelerator pedal position (APP) sensing
- Throttle positioning to meet driver and engine demands
- Throttle position sensing
- Internal diagnostics
- Cruise control functions
- Manage TAC electrical power consumption

The TAC system components include the following:

- The APP sensors
- The throttle body assembly
- The TAC module
- The powertrain control module (PCM)

Accelerator Pedal Position (APP) Sensor

The accelerator pedal assembly contains 2 individual accelerator pedal position (APP) sensors within the assembly. The APP sensors 1 and 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensors are used to determine the pedal angle. The control module provides each APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module with signal voltage proportional to pedal movement. Both APP sensor signal voltages are low at rest position and increase as the pedal is applied.

Throttle Body Assembly

The throttle body assembly consists of the throttle body, the throttle position (TP) sensors, and the throttle actuator motor. The throttle body functions similar to a conventional throttle body with the following exceptions:

- An electric motor opens and closes the throttle valve.
- The throttle blade is spring loaded in both directions and the default position is slightly open.
- There are 2 individual TP sensors within the throttle body assembly.

The TP sensors 1 and 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensors are used to determine the throttle plate angle. The control module provides each TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensors then provide the control module with signal voltage proportional to throttle plate movement. Both TP sensor signal voltages are low at closed throttle and increase as the throttle opens.

Throttle Actuator Control Module

The throttle actuator control (TAC) module is the control center for the throttle actuator control system. The TAC system is self-diagnosing and provides diagnostic information to the powertrain control module (PCM) through a dedicated serial data line. The TAC achieves throttle positioning by providing a pulse width modulated voltage to the TAC, as directed by the PCM.

Powertrain Control Module

The powertrain control module (PCM) determines the driver’s intent, then calculates the appropriate throttle response. This information is sent to the throttle actuator control (TAC) module through a dedicated serial data line.

Modes of Operation

NORMAL MODE

During the operation of the throttle actuator control (TAC) system, several modes or functions are considered normal. The following modes may be entered during normal operation:

- Minimum pedal value – At key-up the PCM updates the learned minimum pedal value.
- Minimum throttle position (TP) values – At key-up the PCM updates the learned minimum TP value. In order to learn the minimum TP value, the throttle blade is moved to the closed position.
- Ice break mode – If the throttle is not able to reach a predetermined minimum throttle position, the ice break mode is entered. During the ice break mode, the control module commands the maximum pulse width several times to the throttle actuator motor in the closing direction.
- Battery saver mode – After a preset time with no engine RPM, the PCM commands battery saver mode. During battery saver mode, the TAC module removes voltage from the motor control circuits, which removes the current draw used to maintain the idle position and allows the throttle to return to the spring loaded default position.

REDUCED ENGINE POWER MODE

When the PCM detects a condition with the TAC system, the PCM may enter a reduced engine power mode. Reduced engine power may cause one or more of the following conditions:

- Acceleration limiting – The control module will continue to use the accelerator pedal for throttle control; however, the vehicle acceleration is limited.
- Limited throttle mode – The control module will continue to use the accelerator pedal for throttle control; however, the maximum throttle opening is limited.
- Throttle default mode – The control module will turn off the throttle actuator motor and the throttle will return to the spring loaded default position.
- Forced idle mode – The control module will perform the following actions:
  - Limit engine speed to idle by positioning throttle position, or by controlling fuel and spark if throttle is turned off.
  - Ignore accelerator pedal input.
- Engine shutdown mode – The control module will disable fuel and de-energize the throttle actuator.

EVAPORATIVE EMISSION CONTROL SYSTEM DESCRIPTION

EVAP System Operation

The evaporative emission (EVAP) control system limits fuel vapors from escaping into the atmosphere. Fuel tank vapors are allowed to move from the fuel tank, due to pressure in the tank, through the vapor pipe, into the EVAP canister. Carbon in the canister absorbs and stores the fuel vapors. Excess pressure is vented through the vent line and EVAP vent solenoid valve to the atmosphere. The EVAP canister stores the fuel vapors until the engine is able to use them. At an appropriate time, the control module will command the EVAP purge solenoid valve ON, allowing engine vacuum to be applied to the EVAP canister. With the EVAP vent solenoid valve OFF, fresh air is drawn through the vent solenoid valve and the vent line to the EVAP canister. Fresh air is drawn through the canister, pulling fuel vapors from the carbon. The air/fuel vapor mixture continues through the EVAP purge pipe and EVAP purge solenoid valve into the intake manifold to be consumed during normal combustion. The control module uses several tests to determine if the EVAP system is leaking.

Large Leak Test

This tests for large leaks and restrictions to the purge path in the EVAP system. When the enabling criteria has been met, the control module commands the EVAP vent solenoid valve ON and the EVAP purge solenoid valve ON, allowing vacuum into the EVAP system. The control module monitors the fuel tank pressure (FTP) sensor voltage to verify that the system is able to reach a predetermined level of vacuum within a set amount of time.

Small Leak Test

The engine off natural vacuum (EONV) diagnostic is the small-leak detection diagnostic for the EVAP system. While previous leak detection methods were performed with the engine running, the EONV diagnostic monitors the EVAP system pressure or vacuum with the ignition OFF. Because of this, it may be normal for the control module to remain active for up to 40 minutes after the ignition is turned OFF. This is important to remember when performing a parasitic draw test on vehicles equipped with EONV.

The EONV utilizes the temperature changes in the fuel tank immediately following a drive cycle to use the naturally occurring vacuum or pressure in the fuel tank. When the vehicle is driven, the temperature rises in the tank. After the vehicle is parked, the temperature in the tank continues to rise for a period of time, then starts to drop. The EONV diagnostic relies on this temperature change and the corresponding pressure change in a sealed system, to determine if an EVAP system leak is present.

The EONV diagnostic is designed to detect leaks as small as 0.51 mm (0.020 in). The diagnostic can determine if a small leak is present based on vacuum or pressure readings in the EVAP system. When the system is sealed, a finite amount of pressure or vacuum will be observed. When a 0.51 mm (0.020 in) leak is present, often little or no pressure or vacuum is observed. If the test reports a failing value, DTC P0442 will set.

Canister Vent Restriction Test

If the EVAP vent system is restricted, fuel vapors will not be properly purged from the EVAP canister. The control module tests this by commanding the EVAP purge solenoid valve ON, commanding the EVAP vent solenoid valve OFF, and monitoring the fuel tank pressure (FTP) sensor for an increase in vacuum. If the vacuum increases more than a calibrated value, DTC P0446 will set.

Purge Solenoid Valve Leak Test

If the EVAP purge solenoid valve does not seal properly fuel vapors could enter the engine at an undesired time, causing driveability concerns. The control module tests for this by commanding the EVAP purge solenoid valve OFF and the vent solenoid valve ON, sealing the system, and monitors the fuel tank pressure (FTP) for an increase in vacuum. If the control module detects that the EVAP system vacuum increases above a calibrated value, DTC P0496 will set.

Check Gas Cap Message

The control module sends a class 2 message to the driver information center (DIC) illuminating the Check Gas Cap message when a malfunction in the evaporative emission (EVAP) system and a large leak test fails.

EVAP System Components

The EVAP system consists of the following components:

EVAP CANISTER

The canister is filled with carbon pellets used to absorb and store fuel vapors. Fuel vapor is stored in the canister until the control module determines that the vapor can be consumed in the normal combustion process.

EVAP PURGE SOLENOID VALVE

The EVAP purge solenoid valve controls the flow of vapors from the EVAP system to the intake manifold. The purge solenoid valve opens when commanded ON by the control module. This normally closed valve is pulse width modulated (PWM) by the control module to precisely control the flow of fuel vapor to the engine. The valve will also be opened during some portions of the EVAP testing, allowing engine vacuum to enter the EVAP system.

EVAP VENT SOLENOID VALVE

The EVAP vent solenoid valve controls fresh airflow into the EVAP canister. The valve is normally open. The control module commands the valve ON, closing the valve during some EVAP tests, allowing the system to be tested for leaks.

FUEL TANK PRESSURE SENSOR

The fuel tank pressure (FTP) sensor measures the difference between the pressure or vacuum in the fuel tank and outside air pressure. The control module provides a 5-volt reference and a ground to the FTP sensor. The FTP sensor provides a signal voltage back to the control module that can vary between 0.1-4.9 volts. A high FTP sensor voltage indicates a low fuel tank pressure or vacuum. A low FTP sensor voltage indicates a high fuel tank pressure.

ELECTRONIC IGNITION (EI) SYSTEM DESCRIPTION

The electronic ignition (EI) system is responsible for producing and controlling a high energy secondary spark. This spark is used to ignite the compressed air/fuel mixture at precisely the correct time. This provides optimal performance, fuel economy, and control of exhaust emissions. This ignition system consists of a separate ignition coil connected to each spark plug by a short secondary wire. The driver modules within each coil assembly are commanded ON/OFF by the PCM. The PCM primarily uses engine speed and position information from the crankshaft and camshaft position (CMP) sensors to control the sequence, dwell, and timing of the spark. The EI system consists of the following components:

Crankshaft Position (CKP) Sensor

The crankshaft position (CKP) sensor is a three wire sensor based on the magneto resistive principle. A magneto resistive sensor uses two magnetic pickups between a permanent magnet. As an element such as a reluctor wheel passes the magnets the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The PCM supplies a 12-volt, low reference, and signal circuit to the CKP sensor. The sensor returns a digital ON/OFF pulse 24 times per crankshaft revolution.

Crankshaft Reluctor Wheel

The crankshaft reluctor wheel is mounted on the rear of the crankshaft. The wheel is comprised of four 90 degree segments. Each segment represents a pair of cylinders at TDC , and is further divided into six 15 degree segments. Within each 15 degree segment is a notch of 1 of 2 different sizes. Each 90 degree segment has a unique pattern of notches. This is known as pulse width encoding. This pulse width encoded pattern allows the PCM to quickly recognize which pair of cylinders are at top dead center (TDC). The reluctor wheel is also a dual track-or mirror image-design. This means there is an additional wheel pressed against the first, with a gap of equal size to each notch of the mating wheel. When one sensing element of the CKP sensor is reading a notch, the other is reading a set of teeth. The resulting signals are then converted into a digital square wave output by the circuitry within the CKP sensor.

Camshaft Position (CMP) Sensor

The CMP sensor is also a magneto resistive sensor, with the same type of circuits as the CKP sensor. The CMP sensor signal is a digital ON/OFF pulse, output once per revolution of the camshaft. The CMP sensor information is used by the PCM to determine the position of the valve train relative to the CKP.

Camshaft Reluctor Wheel

The camshaft reluctor wheel is either pressed onto the camshaft or part of the timing gear depending on the application. The feature-or target- is read in a radial or axial fashion respectively. The wheel is a smooth track, half of which is of a lower profile than the other half. This feature allows the CMP sensor to supply a signal as soon as the key is turned ON, since the CMP sensor reads the track profile, instead of a notch.

Ignition Coils

Each ignition coil has an ignition 1 feed and a ground. The PCM supplies a low reference and an ignition control (IC) circuit. Each ignition coil contains a solid state driver module. The PCM commands the IC circuit ON, allowing current to flow through the primary coil windings for the appropriate time or dwell. When the PCM commands the IC circuit OFF, this interrupts current flow through the primary coil windings. The magnetic field in the primary coil windings collapses across the secondary coil windings, inducing a high voltage across the spark plug electrodes. The coils are current limited to prevent overloading if the IC current is held high too long. Each spark plug is connected to it's respective coil by a short secondary wire. Spark plugs are tipped with iridium for long life/efficiency.

Powertrain Control Module (PCM)

The PCM controls all ignition system functions, and constantly corrects the basic spark timing. The PCM monitors information from various sensor inputs that include the following:

- The throttle position (TP) sensor
- The engine coolant temperature (ECT) sensor
- The mass air flow (MAF) sensor
- The intake air temperature (IAT) sensor
- The vehicle speed sensor (VSS)
- The transmission gear position or range information sensors
- The engine knock sensors (KS)

Modes of Operation

There is one normal mode of operation, with the spark under PCM control. If the CKP pulses are lost the engine will not run. The loss of a CMP signal may result in a longer crank time since the PCM cannot determine which stroke the pistons are on. DTCs are available to accurately diagnose the ignition system with a scan tool.

KNOCK SENSOR (KS) SYSTEM DESCRIPTION

The knock sensor (KS) system enables the control module to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The control module uses the KS system to test for abnormal engine noise that may indicate detonation, also known as spark knock.

Sensor Description

This knock sensor (KS) system uses one or 2 broadband one-wire sensors. The sensor uses piezo-electric crystal technology that produces an AC voltage signal of varying amplitude and frequency based on the engine vibration, or noise, level. The amplitude and frequency are dependant upon the level of knock that the KS detects. The control module receives the KS signal through a signal circuit. The KS ground is supplied by the engine block through the sensor housing.

One way the control module monitors the system is by output of a bias voltage on the KS signal wire. The bias voltage creates a voltage drop that the control module monitors and uses to help diagnose KS faults. The KS noise signal rides along this bias voltage, and due to the constantly fluctuating frequency and amplitude of the signal, will always be outside of the bias voltage parameters.

Another way the control module monitors the system is by learning the average normal noise output from the KS. The control module learns a minimum noise level, or background noise, at idle from the KS and uses calibrated values for the rest of the RPM range. The control module uses the minimum noise level to calculate a noise channel. The control module uses this noise channel, and the KS signal that rides along the noise channel, in much the same way as the bias voltage type does. As engine speed and load change, the noise channel upper and lower parameters will change to accommodate the normal KS signal.

In order to determine which cylinders are knocking, the control module only uses KS signal information when each cylinder is near top dead center (TDC) of the firing stroke. If the control module has determined that knock is present, it will retard the ignition timing to attempt to eliminate the knock. The control module will always try to work back to a zero compensation level, or no spark retard. An abnormal KS signal will fall within the noise channel or will not be present. KS diagnostics are calibrated to detect faults with the KS circuitry inside the control module, the KS wiring, or the KS voltage output.

AIR INTAKE SYSTEM DESCRIPTION

The primary function of the air intake system is to provide filtered air to the engine. The system uses a cleaner element mounted in a housing. The cleaner housing is remotely mounted and uses intake ducts to route the incoming air into the throttle body. The secondary function of the air intake system is to muffle air induction noise. This is achieved through the use of resonators attached to the air intake ducts. The resonators are tuned to the specific powertrain. The mass air flow (MAF) sensor is attached to the outlet of the air cleaner housing. The air cleaner life indicator is located on an intake duct between the air cleaner housing and the throttle plate.

DIAGNOSTIC INFORMATION AND PROCEDURES

4.8L AND 6.0L ENGINE DIAGNOSTICS

Diagnostic Starting Point - Engine Controls

Begin the system diagnosis with Diagnostic System Check - Vehicle . The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and the codes' statuses

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Data List

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Engine Scan Tool Data List only after the following is determined:

- The Diagnostic System Check - Engine Controls is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine.

IMPORTANT:
A scan tool that displays faulty data should not be used. The scan tool problem should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to Symptoms - Engine Controls for diagnosis.

The column labeled Data List indicates where a parameter can be located on the scan tool. Refer to the scan tool operating manual for the exact locations of the data lists. The following is a description of each term listed:

All: The Parameter is in all of the data lists indicated below.

Eng 1: Engine Data 1 List

Eng 2: Engine Data 2 List

EE: Enhanced Evaporative Emission (EVAP) Data

FF/FR: Freeze Frame/Failure Records

FT: Fuel Trim Data List

MF: Misfire Data List

TAC: Throttle Actuator Control (TAC) Data List

CC: Cruise Control Data List

HO2S Data: Heated Oxygen Sensor (HO2S) Data List

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
4WD Signal	Eng 2	Enabled/Disabled	Disabled
4WD Low Signal	Eng 2	Enabled/Disabled	Disabled
A/C Pressure Sensor	Eng 2	Volts	0.98 Volts/Varies
A/C Pressure Sensor	Eng 2	PSI	90 PSI/Varies
A/C Relay Command	Eng 1, 2, MF	On/Off	Off
A/C Request Signal	Eng 2	Yes/No	No
APP Average	TAC	0-100%	0%
APP Indicated Angle	Eng 1, Eng 2, EE, CC, FT, TAC, HO2S	Counts	0
APP Sensor 1	TAC	0-2.5 Volts	0.4-0.9 Volts
APP Sensor 2	TAC	0-5 Volts	0.4-0.9 Volts
APP Sensor 1	TAC	0-100%	0%
APP Sensor 2	TAC	0-100%	0%

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
APP Sensor 1 and 2	TAC	Agree/Disagree	Agree
BARO	Eng 1, EE, FT	kPa	50-104 kPa Varies w/Altitude
CMP Sensor-High to Low	Eng 2	Counts	Varies
CMP Sensor-Low to High	Eng 2	Counts	Varies
Clutch Pedal Switch	Eng 2	Released/Applied	Released
Coolant Level Switch	Eng 2	OK/Low	OK
Cruise Control Active	Eng 1, TAC, CC	Yes/No	No
Cruise Disengage 1 History	CC	Varies	Varies
Cruise Disengage 2 History	CC	Varies	Varies
Cruise Disengage 3 History	CC	Varies	Varies
Cruise Disengage 4 History	CC	Varies	Varies
Cruise Disengage 5 History	CC	Varies	Varies
Cruise Disengage 6 History	CC	Varies	Varies
Cruise Disengage 7 History	CC	Varies	Varies
Cruise Disengage 8 History	CC	Varies	Varies
Cruise Inhibit Signal Command	Eng 1	On/Off	On
Cruise On/Off Switch	CC, TAC	On/Off	Off
Cruise Release Brake Pedal Switch	CC	Released/Applied	Released
Cruise Resume/Accel Switch	CC, TAC	On/Off	Off
Cruise Set/Coast Switch	CC, TAC	On/Off	Off
Current Gear	Eng 1, 2, FT	0-4	1
Cycles of Misfire Data	MF	0-100 Counts	Varies
Decel Fuel Cutoff	HO2S	Active/Inactive	Inactive
Desired IAC Airflow	Eng 1	0-64 g/s	Varies
Desired Idle Speed	Eng 1, Eng 2, TAC, EE	RPM	PCM Controlled
DTC Set This Ignition	Eng 1, 2, CC, EE, FT, HO2S	Yes/No	No
ECT Sensor	Eng 1, Eng 2, EE, FT, MF, HO2S	-39 to +140°C (-38 to +284°F)	88-105°C (190-221°F)
Engine Load	All	0-100%	1-4% @ Idle 7-9% @ 2500 RPM

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
Engine Oil Level Switch	Eng 2	OK/Low	OK
Engine Oil Life Remaining	Eng 2	0-100%	Varies
Engine Oil Pressure Sensor	Eng 2	Volts	1.5 Volts/Varies
Engine Run Time	All	Hrs, Min, Sec	Varies
Engine Speed	All	0-10,000 RPM	500-700 RPM
EVAP Purge Solenoid Command	Eng 1, EE, FT	0-100%	10-25%
EVAP Test Result	EE	Test Result	Varies
EVAP Test State	EE	Test State	Varies
EVAP Vent Solenoid Command	Eng 1, EE, FT	Not Venting/Venting	Venting
Fail Counter	FF	Counts	Varies
Fuel Alcohol Content	Eng 2, FT	%	Varies
Fuel Level Sensor	Eng 1, EE	0-5 Volts	0.7-2.5 Volts
Fuel Level Sensor Rear Tank, if equipped	Eng 1, EE	0-5 Volts	0.7-2.5 Volts
Fuel Tank Level Remaining	EE	Gallon/Liter	Varies
Fuel Tank Level Remaining	EE	0-100%	Varies
Fuel Tank Pressure Sensor	Eng 1, EE	-32.7 to +14.0 mm/Hg (-17.5 to +7.5 in/H2O)	Varies
Fuel Tank Pressure Sensor	EE	0-5.0 volts	Varies
Fuel Tank Rated Capacity	EE	98 Liters (25.9 Gallons) or 129 Liters (34 Gallons)	Varies with Fuel Tank Option
Fuel Temperature	Eng 2	°C/°F	Varies
Fuel Trim Cell	Eng 1, EE, FT	0-23	19
Fuel Trim Learn	Eng 1, EE, FT	Enabled/Disabled	Enabled, May Toggle
Generator F Terminal Signal	Eng 2	Percent	Varies
Generator L Terminal Signal Command	Eng 2	Off/On	On
HO2S Bank 1 Sensor 1	Eng 1, EE, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 1 Sensor 2	Eng 1, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 2 Sensor 1	Eng 1, EE, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 2 Sensor 2	Eng 1, FT, HO2S	Millivolts	10-1,000 mV and Varying

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
HO2S Heater BN 1 Sensor 1	HO2S	Amps	Varies
HO2S Heater BN 1 Sensor 2	HO2S	Amps	Varies
HO2S Heater BN 2 Sensor 1	HO2S	Amps	Varies
HO2S Heater BN 2 Sensor 2	HO2S	Amps	Varies
Hot Run Counter	FF	Counts	Varies
IAT Sensor	Eng 1, Eng 2, EE, FT, HO2S	-39 to +140°C (-38 to +284°F)	35°C (91°F) Depends on Ambient Temperature
Ignition 1 Signal	Eng 1, Eng 2, CC, EE, FT, TAC	0-25 Volts	11.5-14.5 Volts
Inj. PWM Bank 1 Average	Eng 2, FT, MF	Milliseconds	2-6
Inj. PWM Bank 2 Average	Eng 2, FT, MF	Milliseconds	2-6
Knock Retard	Eng 1	0.0-16°	0°
Long Term FT Avg. Bn1	FT	Percentage	Near 0%
Long Term FT Avg. Bn2	FT	Percentage	Near 0%
Long Term FT Bank 1	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Long Term FT Bank 2	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Loop Status	Eng 1, 2, EE, FT, HO2S	Open/Closed	Closed
Low Oil Lamp Command	Eng 2	On/Off	Off
MAF Sensor	Eng 1, Eng 2, EE, MF, FT, TAC, HO2S	Grams Per Seconds (g/s)	1-9 g/s @ Idle, Depends on Altitude 15-26 g/s @ 2,500 RPM, Depends on Altitude
MAF Sensor	Eng 2	0-31,999 Hz	2,000-3,000 Hz
MAP Sensor	Eng 1, Eng 2, EE, FT, MF, TAC, HO2S	kPa	20-48 kPa
MAP Sensor	Eng 1, Eng 2, FF/FR	Volts	1.0-2.0 Volts Varies with Altitude
MIL Command	Eng 2	Off/On	Off
Mileage Since DTC Cleared	Eng 2	kilometers/miles	Varies
Mileage Since First Failure	FF	Counts	Varies
Mileage Since Last Failure	FF	Counts	Varies

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
Misfire Counter Status	MF	Normal/Invalid	Normal
Misfire Current Cyl. 1-8	MF	0-200 Counts	0
Misfire History Cyl. 1-8	MF	0-65,535 Counts	0
Pass Counter	FF	Counts	Varies
PCM Reset	Eng 1, Eng 2, EE, FT	Yes/No	No
PCM/VCM in VTD Fail Enable	Eng 1	Yes/No	No
Power Enrichment	Eng 1, HO2S	Active/Inactive	Inactive
Reduced Engine Power	Eng 1, CC, TAC	Active/Inactive	Inactive
Short Term FT Avg Bn1	FT	Percentage	Near 0%
Short Term FT Avg Bn2	FT	Percentage	Near 0%
Short Term FT Bank 1	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Short Term FT Bank 2	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Spark	Eng 1, Eng 2, FT, MF, HO2S	Degrees	15-20°
Start Up ECT	Eng 2, EE, FT	C°/F°	Varies
Stop Lamp Pedal Switch	CC, TAC	Applied/Released	Released
TAC/PCM Comm Signal	TAC, CC	OK/Fault	OK
TCC Enable Solenoid Command	Eng 1, Eng 2	On/Off	Off
TCC PWM Solenoid Command	Eng 2	On/Off	Off
TFP Switch	Eng 2, CC, FT	Transmission Gear Position	Varies
Torque Delivered Signal	Eng 2, TAC	N·m lb ft	Varies
Torque Request Signal	Eng 2, TAC	N·m lb ft	406 N·m 299 lb ft
TP Desired Angle	Eng 1, Eng 2, EE, TAC, CC	0-100%	5.5%
TP Indicated Angle	All	0-100%	5.5%
TP Sensor 1	TAC	0-5.0 Volts	0.4-0.9 Volts
TP Sensor 1	TAC	0-100%	Varies near 0%
TP Sensor 2	TAC	5.0-0 Volts	Volts
TP Sensor 2	TAC	100-0%	Varies
TP Sensors 1 and 2	TAC	Agree/Disagree	Agree
TR Switch	CC, FT	Transmission Gear	Varies
Traction Control Signal	Eng 2, CC, TAC	Active/Inactive	Inactive

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
Vehicle Speed Sensor	All	km/h mph	0
VTD Auto Learn Timer	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable Until Ign. Off	Eng 1	Yes/No	No
Warm-Ups w/o Emission Faults	Eng 2	0-255 Counts	Varies
Warm-Ups w/o Non-Emission Faults	Eng 2	0-255 Counts	Varies

Scan Tool Data Definitions

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters available on the scan tool. The list is in alphabetical order. A given parameter may appear in any one of the data lists. In some cases, the parameter may appear more than once or in more than one data list in order to group certain related parameters together.

- 4WD Signal: (Not used on WCC vehicles) This parameter displays the state of the transfer case based on the signal from the front axle indicator switch. The scan tool will display Enabled or Disabled. Enabled indicates the front axle is locked in four wheel drive and the front axle indicator switch is closed, supplying voltage to the controller on the axle switch signal circuit. Disabled indicates the transfer case is not in four wheel drive and the front axle indicator switch is open.
- 4WD Low Signal: (Not used on WCC vehicles) This parameter displays the state of the transfer case based on the signal from the four wheel drive (4WD) low switch. The scan tool will display Enabled or Disabled. Enabled indicates the transfer case is in 4WD low gear and the 4WD low switch is closed, completing the low signal circuit. Disabled indicates the transfer case is not in 4WD low gear and the 4WD low switch is open.
- A/C Relay Command: This parameter displays the commanded state of the air conditioning (A/C) clutch relay control circuit. The scan tool will display ON or OFF. ON indicates the A/C clutch relay control circuit is being grounded by the control module, allowing voltage to the A/C compressor clutch. OFF indicates the A/C clutch relay is not being commanded on by the control module.

- A/C Request Signal: This parameter displays the state of the air conditioning (A/C) request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls. The scan tool will display Yes or No. Yes indicates the control module is receiving a request from the HVAC system to ground the A/C clutch relay control circuit, engaging the A/C compressor clutch. No indicates the control module is not receiving a request from the HVAC system to ground the A/C clutch relay control circuit.
- APP Average: This parameter displays the average of the 3 accelerator pedal position (APP) sensors as calculated by the throttle actuator control (TAC) module. The APP average is a range of values indicating a low number when the accelerator pedal is not pressed to a high number when the accelerator pedal is fully pressed. This value is listed in counts.
- APP Indicated Angle: This parameter displays the angle of the accelerator pedal as calculated by the control module using the signals from the accelerator pedal position sensors. The APP indicated angle is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.
- APP Sensor 1: This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 1 of the APP sensor assembly. APP sensor 1 is a range of values indicating a low voltage when the accelerator pedal is not pressed to a high voltage when the accelerator pedal is fully pressed.
- APP Sensor 1: This parameter displays the angle of the accelerator pedal position (APP) sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.
- APP Sensor 1 and 2: This parameter displays the results of a control module test that compares the signals from the accelerator pedal position (APP) sensors 1 and 2 . The scan tool will display Agree or Disagree. Agree indicates that APP sensor 1 and APP sensor 2 voltages correspond to the same accelerator pedal position. Disagree indicates that APP sensor 1 and APP sensor 2 voltages correspond to different accelerator pedal positions.
- APP Sensor 2: This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of values indicating a low voltage when the accelerator pedal is not pressed to a high voltage when the accelerator pedal is fully pressed.

- APP Sensor 2: This parameter displays the angle of the accelerator pedal position (APP) sensor 2 as calculated by the control module using the signal from the APP sensor 2. APP sensor 2 is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.
- BARO : This parameter displays the barometric pressure as calculated by the control module using the signal from the manifold absolute pressure (MAP) sensor measured when the ignition is turned on with the engine not running. The control module will update the barometric pressure during wide-open throttle (WOT) conditions.
- Clutch Pedal Switch: This parameter displays the current state of the clutch pedal as determined by the control module.
- CMP Sensor - High To Low: This parameter displays the number of times the signal voltage from the camshaft position (CMP) sensor changes from high to low. The scan tool will display these transitions as counts.
- CMP Sensor - Low To High: This parameter displays the number of times the signal voltage from the camshaft position (CMP) sensor changes from low to high. The scan tool will display these transitions as counts.
- Coolant Level Switch: This parameter displays the level of engine coolant as determined by the control module. The control module determines the level of the coolant using the signal from a switch used to monitor the engine coolant level. The scan tool will display low when the engine coolant level is low. The scan tool will display OK when the coolant level is correct.
- Cruise Control Active: This parameter displays the status of the cruise control system as determined by the control module. The scan tool will display Yes when the cruise control system is in control of vehicle speed. The scan tool will display No when the cruise control system is not operating.
- Cruise Disengage 1-8 History: The scan tool indicates the last 8 cruise control disengages in order, from 1 to 8. There are 20 possible causes for the cruise control to disengage.
- Cruise Inhibit Signal Command: This parameter displays the commanded state of the cruise inhibit signal circuit. The scan tool will display On when the control module is inhibiting cruise control operation. The scan tool will display OFF when the control module is allowing cruise control operation.
- Cruise On/Off Switch: This parameter displays the state of the On/Off switch input to the control module . The scan tool will display ON when the cruise switch is ON.

- Cruise Release Brake Pedal Switch: This parameter displays the state of the Cruise Release Brake Pedal Switch as determined by the control module. The scan tool will display Released or Applied. Released indicates the brake pedal is not being pushed down , allowing the cruise control to be enabled. Applied indicates the brake switch is being applied, disabling cruise control operation.
- Cruise Resume/Accel Switch: This parameter displays the state of the Resume/Accel switch input to the control module when the cruise control switch is in the on position and the Resume/Accel switch is activated, the scan tool displays On. When the Resume/Accel switch is released the scan tool displays OFF.
- Cruise Set/Coast Switch: This parameter displays the state of the Set/Coast switch input to the control module from the cruise control system. When the cruise control switch is in the on position and the Set/Coast switch is activated, the scan tool displays On. When the Set/Coast switch is released the scan tool displays OFF.
- Current Gear: This parameter displays the transmission gear commanded by the control module. The scan tool will display 1 when the control module has commanded first gear regardless of the gear selector position. The scan tool will display up to 6 depending upon which gear is commanded and what transmission is in the vehicle. The scan tool will display 9 if the transmission gear is not known.
- Cycles Of Misfire Data: This parameter displays the number of cylinder firing events that were recorded as misfires as determined by the control module.
- Decel. Fuel Cutoff: This parameter displays the status of the operating mode used to turn OFF the fuel injectors during certain deceleration conditions. When the scan tool displays Active, the control module has turned OFF the fuel injectors. When the scan tool displays Inactive, the fuel system is operating normally.
- Desired IAC Airflow: This parameter displays the desired airflow in the idle air control (IAC) passage as calculated by the control module.
- Desired Idle Speed: This parameter displays the engine idle speed in RPM commanded by the control module. The control module compensates for various engine loads in order to maintain the desired engine RPM at idle. This parameter is not valid unless the engine is running.
- DTC Set This Ignition: This parameter displays if a diagnostic trouble code (DTC) set during the current ignition cycle. The scan tool will display YES if a DTC is stored this ignition cycle.
- ECT Sensor: This parameter displays the temperature of the engine coolant based on a voltage input from the engine coolant temperature (ECT) sensor to the control module. The scan tool will display a low value when coolant temperature is low, and a high value when the coolant temperature is high.

- Engine Load: This parameter displays the engine load in percent based on inputs to the control module from various engine sensors. The scan tool will display a low percentage when the engine is at idle with little or no load. The scan tool will display a high percentage when the engine is running at a high RPM under a heavy load.
- Engine Oil Level Switch: This parameter displays the state of the engine oil level switch as determined by the control module. The scan tool will display OK or Low. OK indicates that the engine oil level is not too low for safe operation of the engine. Low indicates the engine oil level is abnormally low and has closed the engine oil level switch.
- Engine Oil Life Remaining: This parameter displays the amount of engine oil life remaining before requiring an oil change. This number is calculated by the control module based on many inputs and is displayed as a percent. The lower the percentage, the sooner the next oil change will be required.
- Engine Run Time: This parameter displays the time elapsed since the engine was started. The scan tool will display the time in hours, minutes and seconds. The engine run time will reset to zero as soon as the engine stops running.
- Engine Speed: This parameter displays the speed of the crankshaft as calculated by the control module based on inputs from the crankshaft position (CKP) sensor. The scan tool will display the engine speed in revolutions per minute (RPM).
- EVAP Purge Solenoid Command: This parameter displays the on-time or duty cycle of the evaporative emission (EVAP) purge solenoid commanded by the control module expressed as a percent. The scan tool will display a high percentage when the control module is commanding the EVAP purge solenoid to be open a large amount . The scan tool will display a low percentage when the control module is commanding the EVAP purge solenoid to be open a small amount. The scan tool will display 0 when the control module is commanding the EVAP purge solenoid closed.
- EVAP Test Result: The scan tool displays No Result, Passed, Aborted, Fail-DTC P0440, Fail-DTC P0442, Fail-DTC P0446, or Fail-DTC P1441. The scan tool displays PASS if the control module determines that the EVAP test has passed.
- EVAP Test State: The scan tool displays Waiting For Purge, Test Running, or Test Completed. This parameter indicates the state of the EVAP service bay test.

- EVAP Vent Solenoid Command: This parameter displays the commanded state of the EVAP vent solenoid control circuit . The scan tool will display Venting or Not Venting. Venting indicates the EVAP vent solenoid is not being commanded on by the control module. Not Venting indicates the EVAP vent solenoid is being commanded ON by the control module.
- Fail Counter: The scan tool displays the number of times that a diagnostic has failed.
- Fuel Alcohol Content: This parameter displays the percentage of alcohol in the fuel. This value is calculated by the control module using HO2S signals. The scan tool will display a low percentage when there is very little alcohol in the fuel. The scan tool will display a high percentage when the alcohol content of the fuel is high.
- Fuel Level Sensor: This parameter displays the voltage from the signal produced by the sensor used to monitor the fuel level inside the fuel tank. The scan tool will display a low voltage reading when the fuel level in the tank is low or near empty. The scan tool will display a high voltage reading when the fuel level in the tank is high or near full.
- Fuel Level Sensor Rear Tank: This parameter displays the voltage from the signal produced by the sensor used to monitor the fuel level inside the rear fuel tank. The scan tool will display a low voltage reading when the fuel level in the rear tank is low or near empty. The scan tool will display a high voltage reading when the fuel level in the tank is high or near full.
- Fuel Tank Level Remaining: This parameter displays the amount of fuel remaining in all fuel tanks of the vehicle as measured in liters or gallons. The control module calculates the amount of fuel remaining in the tank by using information from the fuel level sensors.
- Fuel Tank Level Remaining: This parameter displays the amount of fuel remaining in tall of the fuel tanks of the vehicle as a percentage. The control module calculates this level using the signals from the sensors used to monitor the fuel level in the fuel tanks. The scan tool will display a low reading when the total fuel level in the vehicle is low or near empty. The scan tool will display a high reading when the fuel level in the tank is high or near full.
- Fuel Tank Pressure Sensor: This parameter indicates the pressure or vacuum in the fuel tanks as determined by the control module based on inputs from the fuel tank pressure sensor. The scan tool displays in mm/Hg or in H2O. The scan tool indicates a negative value if there is a vacuum in the fuel tank, and a positive value if there is pressure in the fuel tank.

- Fuel Tank Pressure Sensor: This parameter displays the voltage signal sent to the control module from the sensor used to monitor the pressure inside the fuel tank. The scan tool will display a low voltage when the pressure in the fuel tank is high. The scan tool will display a high voltage when the pressure in the fuel tank is low or in a vacuum.
- Fuel Tank Rated Capacity: The scan tool displays liters or gallons. This parameter displays the fuel tank capacity as determined by the calibrations of the vehicle.
- Fuel Temperature: This parameter displays the current fuel temperature as calculated by the control module based on input from the fuel composition sensor. The scan tool will display a higher value at higher fuel temperatures. The scan tool will display a lower value at lower fuel temperatures.
- Fuel Trim Cell: This parameter displays the fuel trim cell as calculated by the control module based on many sensor inputs. The fuel trim cell indicates which cell is currently active.
- Fuel Trim Learn: The scan tool displays Enabled or Disabled. When conditions are appropriate for enabling long term fuel trim corrections, the scan tool displays Enabled. If the scan tool displays Disabled, then long term fuel trim will not respond to changes in short term fuel trim.
- Generator F-Terminal Signal : This parameter displays the commanded state of the generator by the control module. A high value indicates a high charging command, and a low value indicates a low charging command.
- Generator L-Terminal Signal Command: This parameter displays if the control module is allowing the generator to operate. The scan tool displays ON if the generator is allowed to operate. The scan tool displays OFF if the control module is disabling the generator.
- HO2S Bank 1 Sensor 1: This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor fuel trim for cylinder bank 1. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.
- HO2S Bank 1 Sensor 2: This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor catalyst efficiency for cylinder bank 1. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.

- HO2S Bank 2 Sensor 1: This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor fuel trim for cylinder bank 2. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.
- HO2S Bank 2 Sensor 2: This parameter displays the voltage from the signal produced by the heated oxygen sensor used to catalyst efficiency for cylinder bank 2. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.
- HO2S Heater Bank 1 Sensor 1: This parameter displays the current through the control module when the bank 1 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bank 1 Sensor 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.
- HO2S Heater Bank 1 Sensor 2: This parameter displays the current through the control module when the bank 1 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bank 1 Sensor 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.
- HO2S Heater Bank 2 Sensor 1: This parameter displays the current through the control module when the bank 2 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bank 2 Sensor 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.
- HO2S Heater Bank 2 Sensor 2: This parameter displays the current through the control module when the bank 2 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bank 2 Sensor 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.
- IAT Sensor: This parameter displays the temperature of the intake air calculated by the control module based on the input from the intake air temperature (IAT). The scan tool will display a low value for a low intake air temperature, and a high value for a high intake air temperature.
- Ignition 1 Signal: This parameter displays the voltage measured at the ignition 1 circuit of the control module. Voltage is applied to the control module when the ignition switch is in the ignition 1 position.

- Injector PWM Bank 1 Average: The scan tool displays milliseconds. This parameter is the average time the control module turns on each fuel injector on that bank. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.
- Injector PWM Bank 2 Average: The scan tool displays milliseconds. This parameter is the average time the control module turns on each fuel injector on that bank. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.
- Knock Retard: The scan tool displays in degrees. This parameter indicates the amount of timing retard commanded by the control module. The scan tool will display a lower value if no knock is detected, and a higher value as more knock is detected and the control module retards the ignition timing.
- Long Term FT Avg. Bn1: The scan tool displays %. This parameter is the average long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Long Term FT Avg. Bn2: The scan tool displays %. This parameter is the average long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Long Term FT Bank 1: The scan tool displays %. This parameter is the long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

- Long Term FT Bank 2: The scan tool displays %. This parameter is the long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Loop Status: The scan tool displays Open or Closed. The scan tool displays Closed Loop if the control module is controlling the fuel delivery according to the heated oxygen sensor (HO2S) voltages. The scan tool displays open loop if the control module is not adjusting for HO2S inputs. In open loop the control module bases fuel deliver on throttle position, engine coolant temperature, and mass airflow sensor inputs.
- Low Oil Lamp Command: This parameter displays the commanded state of the low oil lamp control circuit by the control module. The scan tool will display ON if the lamp is commanded ON by the control module. The scan tool will display OFF if the lamp is not being commanded by the control module.
- MAF Sensor: The scan tool displays g/s. This parameter indicates the airflow into the engine as calculated by the control module based on mass airflow (MAF) sensor inputs. The scan tool will display a high value at higher engine speeds, and a low value at idle.
- MAF Sensor: The scan tool displays in Hz. This parameter indicates the frequency signal sent from the MAF sensor to the control module. the scan tool will display a high value indicates a higher engine speed. The scan tool will display a low value at idle.
- MAP Sensor: The scan tool displays kPa. This parameter displays the pressure inside of the intake manifold as calculated by the control module based on the input from the MAP sensor. The scan tool will display a high value at wide open throttle (WOT). The scan tool will display a low value at idle speed.
- MAP Sensor: This parameter displays the voltage signal from the MAP sensor to the control module. The scan tool will display a high value at wide open throttle (WOT). The scan tool will display a low value at idle speed.
- MIL Command: This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit. The malfunction indicator lamp should be ON when the scan tool indicates the MIL Command is ON. The malfunction indicator lamp should be OFF when the scan tool indicates the MIL Command is OFF. The control module will command the MIL ON when the ignition is ON with the engine OFF in order to perform a bulb check.

- Mileage Since DTC Cleared: The scan tool displays km or miles. This parameter indicates the mileage accumulated since an emission diagnostic trouble code cleared.
- Mileage Since First Failure: The scan tool will display in km or miles. This parameter indicates the difference in mileage between when the DTC first set and the current vehicle mileage as calculated by the control module.
- Mileage Since Last Failure: The scan tool will display in km or miles. This parameter indicates the difference in mileage between when the DTC last set and the current vehicle mileage as calculated by the control module.
- Misfire Counter Status: The misfire counter shows the relative number of failed misfire tests since the misfire DTC P0300 became active.
- Misfire Current Cyl. #1 - #8: The scan tool will display in counts. This parameter indicates the number of cylinder firing events detected as possible misfires on each cylinder during the last 200 crankshaft revolutions as calculated by the control module. The scan tool will display a low number for a low number of cylinder misfire events. The scan tool will display a high number for a high number of cylinder misfire events.
- Misfire History Cyl. #1 - #8: The scan tool displays in counts. This parameter displays the total level of cylinder misfires that have been calculated for each cylinder by the control module. This parameter will not update or show activity until a misfire DTC has become active. The misfire history counters will update every 200 cylinder firing events.
- Not Run Counter: The scan tool displays the number of times a DTC diagnostic has not reached the predetermined criteria in order to run since the first DTC run failure.
- Pass Counter: The scan tool displays the number of times a DTC has run and passed.
- PCM Reset: The scan tool displays Yes or No. This parameter indicates when the internal PCM resets. The scan tool displays YES when an internal PCM reset occurred. The scan tool displays NO under the normal operating conditions.
- PCM/VCM in VTD Fail Enable: The scan tool displays Yes or No. The scan tool displays Yes if the body control module (BCM) and the control module lose communications with each other after the BCM sends the correct password. The scan tool displays No if the BCM is communicating the correct password to the PCM.

- Power Enrichment: Scan tool displays ACTIVE or INACTIVE. ACTIVE displayed indicates that the control module has detected conditions appropriate to operate in Power Enrichment mode. The control module commands Power Enrichment mode when a large increase in throttle position and load is detected. While in Power Enrichment, the control module will increase the amount of fuel delivered by entering Open Loop and increasing the injector pulse width.
- Reduced Engine Power: The scan tool displays Active or Inactive. The scan tool displays Active when the control module receives a signal from the TAC module that a throttle actuator control system fault is occurring. The scan tool displays inactive when the engine is operating normally.
- Short Term FT Avg. Bn1: The scan tool displays %. This parameter indicates the average short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Short Term FT Avg. Bn2: The scan tool displays %. This parameter indicates the average short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Short Term FT Bank 1: The scan tool displays %. This parameter indicates the current short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

- Short Term FT Bank 2: The scan tool displays %. This parameter indicates the current short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.
- Spark: This parameter is the desired spark advance calculated by the control module based on many sensor inputs. The scan tool will display a lower value at idle speed, and a higher value under heavy acceleration and load conditions.
- Start Up ECT: This parameter indicates the engine coolant temperature at startup, as calculated by the control module based on the input from the engine coolant temperature sensor. The scan tool will display a higher value at higher engine startup temperatures, and a lower value at lower startup temperatures.
- Stop Lamp Pedal Switch: This parameter displays the state of the brake pedal as determined by the control module based on an input from the stop lamp pedal switch. This switch turns ON the stop lamps when the brake pedal is pressed. The scan tool will display Applied when the brake pedal is pressed.
- TAC/PCM Communication Signal: This parameter indicates the status of the communication between the TAC module and the control module. The scan tool will display OK if the circuits are operating normally. The scan tool will display Fault if there is an interrupt in the communication.
- TCC Enable Solenoid Command: This parameter displays the commanded state of the torque converter clutch (TCC) solenoid control circuit. The scan tool will display ON or OFF. ON indicates the TCC solenoid control circuit is being grounded by the control module, operating the torque converter. OFF indicates the TCC solenoid is not being commanded ON by the control module.
- TCC PWM Solenoid Command: This parameter indicates the commanded state of the TCC PWM Solenoid by the control module. The scan tool displays ON or OFF. The scan tool displays ON when the commanded state of the solenoid is ON. The scan tool displays OFF when the solenoid is OFF.
- TFP Switch: The scan tool displays Park/Neutral, Reverse, Drive, or Invalid. This display indicates the decoded status of the two A/B inputs from the automatic transmission fluid pressure manual valve position switch.

- Torque Delivered Signal: The scan tool displays ft-lbs or N·m. This parameter represents the pulse width modulation (PWM) signal which indicates the percent of available torque the engine is delivering to the drive wheels. The electronic brake/traction control module (EBCM) monitors the Traction Control Torque signal to ensure that the powertrain control module (PCM) is responding properly to the Traction Control Desired Torque signal.
- Torque Request Signal: The scan tool displays ft-lbs or N·m. Represents the pulse width modulation (PWM) signal from the electronic brake and traction control module. The electronic brake/traction control module (EBCM) reduces the traction control desired torque signal pulse width when a drive wheel slippage situation is detected. The powertrain control module (PCM) monitors the traction control desired torque signal and reduces drive wheel slippage as necessary by retarding spark timing, decreasing boost solenoid PWM, or increasing air/fuel ratio. The PCM can also turn OFF up to three fuel injectors if the traction control desired torque signal indicates a large enough amount of drive wheel slippage.
- TP Desired Angle: This parameter indicates the TP angle commanded by the control module. The scan tool will display a low value at idle, and a high value at wide open throttle (WOT).
- TP Indicated Angle: This parameter displays the angle of the throttle position (TP) in percent. This information is calculated by the control module using the signals from the throttle position sensors. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.
- TP Sensor 1: This parameter displays the voltage signal sent to the control module from the sensor used to monitor the position of the throttle plates. This parameter is for sensor 1 of the throttle position (TP) sensor assembly. The scan tool will display a low voltage when the throttle plates are at rest. The scan tool will display a high voltage when the throttle plates are fully open.
- TP Sensor 1: This parameter displays the angle of the throttle position (TP) sensor 1 in percent. This information is calculated by the control module using the signal from the throttle position sensor 1. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.
- TP Sensor 2: This parameter displays the voltage signal sent to the control module from the sensor used to monitor the position of the throttle plates. This parameter is for sensor 2 of the throttle position (TP) sensor assembly. The scan tool will display a high voltage when the throttle plates are at rest. The scan tool will display a low voltage when the throttle plates are fully open.

- TP Sensor 2: This parameter displays the angle of the throttle position (TP) sensor 2 in percent. This information is calculated by the control module using the signal from the throttle position sensor 2. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.
- TP Sensors 1 and 2: This parameter displays the results of a control module test that compares signals from the throttle position (TP) sensors 1 and 2 . The scan tool will display Agree when the signal from TP sensor 1 corresponds with the signal from TP sensor 2. The scan tool will display Disagree when the signal from TP sensor 1 conflicts with the signal from TP sensor 2.
- TR Switch: This parameter indicates the current state of the gear select switch on the transmission/transaxle as calculated by the control module based on the TR switch. The scan tool status will switch from High to Low as different combinations are met. On the scan tool in Park, the PRNDL would read P and A will be Low, and B and C will be High.
- Traction Control Signal: (Not used on WCC vehicles) This parameter displays the current status of the traction control system. The scan tool will display ACTIVE if the traction control system is operating. The scan tool will display INACTIVE if the traction control system is not requested because of a wheel slippage condition.
- Vehicle Speed Sensor: This parameter indicates the vehicle speed calculated by the control module based on an input from the vehicle speed sensor (VSS). The scan tool will display a high value at higher vehicle speeds, and a low value at lower vehicle speeds.
- VTD Auto Learn Timer: The scan tool displays Active/Inactive. This parameter indicates if the control module is ready to learn the theft deterrent password. The scan tool will display active if the system is ready to learn. The scan tool will display inactive if the system has timed out or is not ready to learn the password.
- VTD Fuel Disable: This parameter Indicates if the VTD module has received proper information to enable or disable fuel. The scan tool will display Active or Inactive. The scan tool will display Active if the control module does not receive the correct password from the BCM. The scan tool will display Inactive if the control module receives the correct password from the BCM. If the system is Active, the engine will not start.
- VTD Fuel Disable Until Ignition Off: The scan tool displays Yes or No. With the ignition ON and a VTD code present, the scan tool displays Yes.

- Warm-ups w/o Emission Faults: The scan tool displays in counts. This parameter counts the number of warm up cycles without an emission fault present. The parameter increments until a fault occurs. If a fault occurs, the counter reverts to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM also resets the counter to 0.
- Warm-ups w/o Non-Emission Faults: The scan tool displays in counts. This parameter counts the number of warm up cycles without a non-emission fault present. The parameter increments until a fault occurs. If a fault occurs, the counter reverts to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM also resets the counter to 0.

Scan Tool Output Controls

Scan Tool Output Controls		
Scan Tool Output Control	**Additional Menu Selection(s)**	**Description**
Crankshaft Position Variation Learn	—	Enables the powertrain control module (PCM) to learn the variations in the crankshaft position (CKP) system. The PCM will learn the variations once the following conditions are met: • Engine coolant temperature (ECT) is more than a specified value. • All instructions on the scan tool have been completed. • The accelerator pedal is smoothly applied until the fuel cut-OFF, as specified on the scan tool, is achieved, and then immediately released. The PCM learns the variation values on the deceleration from fuel cut-OFF.
Cylinder Power Balance	Fuel System	Enables/Disables a cylinder by turning OFF the fuel injector to the cylinder. The fuel injector is normally enabled. The PCM disables the fuel injector when the following conditions are met: • All instruction on the scan tool are completed • Stabilized engine speed • The fuel injector is selected When Disable is selected the PCM turns the injector OFF for 30 seconds. During this period, the engine operates with a misfire.

Scan Tool Output Controls		
Scan Tool Output Control	**Additional Menu Selection(s)**	**Description**
Engine Speed Control	TAC System	Activates the throttle activation control (TAC) system to change engine RPM. The normal commanded state is None. To enable the RPM control, all instruction on the scan tool must be completed. The system will increase or decrease the RPM within a range of 350-2000 RPM. The set step value changes the RPM by increments of 25 RPM, 100 RPM, and 500 RPM. The system remains in the commanded state until cancelled by the scan tool.
EVAP Purge Solenoid	Engine Output Controls/ EVAP System	Activates the evaporative emission (EVAP) purge valve. The normal commanded state is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within a range of 0-100 percent. The system remains in the commanded state until cancelled by the tool or the fuel tank pressure (FTP) exceeds 32 mm Hg (17 in H20).
EVAP Purge/Seal	Engine Output Controls/ EVAP System	This control enables two functions. One function increases or decreases the amount of purge by changing the duty cycle of the purge valve and commanding the vent ON, non-venting. The normal commanded state of both valves is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within a range of 0-100 percent. The second function seals the system after using the purge function to obtain a specific amount of FTP. When activated the purge valve is commanded to 0 percent and the vent valve is commanded ON, non-venting. Both functions remain in the commanded state until one of the following conditions occurs: • Cancelled by the tool • The FTP exceeds 32 mm Hg (17 in H20)
EVAP Vent Solenoid	Engine Output Controls/ EVAP System	Activates the EVAP vent solenoid. The normal commanded state is None. When commanded ON, the vent valve switches to non-venting. The system remains in the commanded state until one of the following conditions occurs: • Cancelled by the tool • Purge is greater than 0 percent, and the fuel tank pressure exceeds 32 mm Hg (17 in H20)
Fuel Composition Reset	Fuel System	**IMPORTANT:** *Do not use this output control unless the actual alcohol content in the fuel tank is 10% or less. False DTCs may set as a result.* **IMPORTANT:** *This output control does not initiate a PCM fuel composition learn event.* This output control will reset the control module learned alcohol composition percentage to 3.

Scan Tool Output Controls		
Scan Tool Output Control	**Additional Menu Selection(s)**	**Description**
Fuel Injector Balance	Fuel System	Enables the fuel injector in order to verify proper fuel injector flow. The PCM will pulse the selected injector when the following conditions are met: • All instruction on the scan tool completed • Fuel injector selected • Key ON, engine OFF The selected fuel injector can only be flowed/pulsed once per ignition cycle.
Fuel Pump	Engine Output Controls	Controls the fuel pump relay. The normal commanded state is None. When commanded ON/OFF, the PCM turns the fuel pump ON/OFF. If the engine is running, and the fuel pump is commanded OFF, the engine will stall. The system remains in the commanded state until cancelled by the scan tool.
Fuel Trim Enable	Fuel System	Disables the PCMs ability to learn new fuel trim parameters. The system remains in the commanded state until cancelled by the scan tool.
Fuel Trim Reset	Fuel System	Activates the reset of fuel trim data in all of the fuel trim cells.
Loop Status	Engine Output Controls	Controls the system loop status. The commanded states include None, Open, or Closed. The normal commanded state is None. When commanded Open or Closed, the system remains in the commanded state until cancelled by the scan tool.
Malfunction Indicator Lamp	Engine Output Controls	Controls the malfunction indicator lamp (MIL). The commanded states include None, ON, and OFF. When commanded ON or OFF, the system remains in the commanded state until cancelled by the scan tool.
Misfire Graphic	—	Graphs the accumulated misfires occurring in each cylinder. The scan tool allows for a reset of the misfire graph.
O2S Heater Control	Engine Output Controls	Activates the HO2S Heater. The commanded states include None, ON, and OFF. The normal commanded state is None. On a cold engine, with the key ON, engine OFF, the HO2S signal will continue to drop below bias when commanded ON. The system remains in the commanded state until cancelled by the tool.

DTC P0030 or P0050

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the engine control module (ECM).

The ECM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The ECM monitors the voltage on the HO2S heater low control circuit for heater fault diagnosis. If the ECM detects that the HO2S heater low control circuit voltage is not within a specified range, DTC P0030 sets for HO2S bank 1 sensor 1 or DTC P0050 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0030 HO2S Heater Control Circuit Bank 1 Sensor 1
- DTC P0050 HO2S Heater Control Circuit Bank 2 Sensor 1

Conditions for Running the DTC

- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the affected HO2S heater low control circuit is not within a specified range for 6 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0030 or P0050				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S Heater Current parameter with a scan tool. Is the HO2S Heater Current parameter within the specified range?	0.25-3.125 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 5	Go to Step 6

DTC P0030 or P0050				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0030 or P0050				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0030 or P0050				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to the following: • Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 • Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2A or O2B fuse, if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0036 or P0056 (w/4.8L)

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the engine control module (ECM).

The ECM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The ECM monitors the voltage on the HO2S heater low control circuit for heater fault diagnosis. If the ECM detects that the HO2S heater low control circuit voltage is not within a specified range, DTC P0036 sets for HO2S bank 1 sensor 2, or DTC P0056 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0036 HO2S Heater Control Circuit Bank 1 Sensor 2
- DTC P0056 HO2S Heater Control Circuit Bank 2 Sensor 2

Conditions for Running the DTC

- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the affected HO2S heater low control circuit is not within a specified range for 6 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0036 or P0056 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S Heater Current parameter with a scan tool. Is the HO2S Heater Current parameter within the specified range?	0.25-1.625 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 5	Go to Step 6

DTC P0036 or P0056 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0036 or P0056 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0036 or P0056 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to the following: • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2 Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2A or O2B fuse, if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0036 or P0056 (w/6.0L)

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the engine control module (ECM).

The ECM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The ECM monitors the voltage on the HO2S heater low control circuit for heater fault diagnosis. If the ECM detects that the HO2S heater low control circuit voltage is not within a specified range, DTC P0036 sets for HO2S bank 1 sensor 2, or DTC P0056 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0036 HO2S Heater Control Circuit Bank 1 Sensor 2
- DTC P0056 HO2S Heater Control Circuit Bank 2 Sensor 2

Conditions for Running the DTC

- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the affected HO2S heater low control circuit is not within a specified range for 6 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0036 or P0056 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S Heater Current parameter with a scan tool. Is the HO2S Heater Current parameter within the specified range?	0.25-1.375 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 5	Go to Step 6

DTC P0036 or P0056 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *he test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1 Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0036 or P0056 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0036 or P0056 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to the following: • Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 • Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2A or O2B fuse, if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0053 or P0059

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM calculates the heater resistance on a cold start. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater calculated resistance is not within an expected range, DTC P0053 sets for HO2S bank 1 sensor 1, or DTC P0059 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0053 HO2S Heater Resistance Bank 1 Sensor 1
- DTC P0059 HO2S Heater Resistance Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P2610 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 and +45°C (-22 and +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is started.

Conditions for Setting the DTC

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up for one 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 number below refers to the step number on the diagnostic table.

7. With no fault present, the test lamp will blink once per second.

DTC P0053 or P0059				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A fuse. Is the O2A fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0053 or P0059				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0053 or P0059				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0053 or P0059				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2A fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21

DTC P0053 or P0059				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0054 or P0060 (w/4.8L)

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM calculates the heater resistance on a cold start. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater calculated resistance is not within an expected range, DTC P0054 sets for HO2S bank 1 sensor 2, or DTC P0060 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0054 HO2S Heater Resistance Bank 1 Sensor 2
- DTC P0060 HO2S Heater Resistance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P2610 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 and +45°C (-22 and +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is started.

Conditions for Setting the DTC

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up for 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 number below refers to the step number on the diagnostic table.

7. With no fault present, the test lamp will blink once per second.

DTC P0054 or P0060 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.625 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2B fuse. Is the O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0054 or P0060 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0054 or P0060 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0054 or P0060 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21

DTC P0054 or P0060 (w/4.8L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0054 or P0060 (w/6.0L)

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM calculates the heater resistance on a cold start. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater calculated resistance is not within an expected range, DTC P0054 sets for HO2S bank 1 sensor 2, or DTC P0060 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0054 HO2S Heater Resistance Bank 1 Sensor 2
- DTC P0060 HO2S Heater Resistance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P2610 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 and +45°C (-22 and +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is started.

Conditions for Setting the DTC

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up for one 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 number below refers to the step number on the diagnostic table.

7. With no fault present, the test lamp will blink once per second.

DTC P0054 or P0060 (w/6.0L)				
Step	Action	Value(s)	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.375 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2B fuse. Is the O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0054 or P0060 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0054 or P0060 (w/6.0L)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0054 or P0060 (w/6.0L)				
Step	Action	Value(s)	Yes	No
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21

DTC P0054 or P0060 (w/6.0L)				
Step	Action	Value(s)	Yes	No
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0068

Circuit Description

The powertrain control module (PCM) uses the following readings to calculate the predicted mass air flow (MAF) rate:

- The throttle position (TP)
- The barometric pressure (BARO)
- The intake air temperature (IAT)
- The engine RPM

The PCM compares the predicted MAF value to the actual MAF value, and to the speed density calculation, in order to verify the proper throttle operation.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0068 Throttle Body Airflow Performance

Conditions for Running the DTC

- DTCs P0601, P0602, P0604, P0606, P1516, P2101, P2108, U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.
- The engine operates longer than 1 second.
- The engine speed is more than 500 RPM.
- DTC P0068 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the difference between the actual airflow and the speed density calculated air flow is greater than expected for more than 1.88 seconds.

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 throttle blade for being broken, bent, or missing.
- Inspect the TP sensor for proper installation. A sensor that is misaligned could set this DTC.
- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Physically and visually inspect the throttle body assembly and correct any problems that you observe. Manually move the throttle blade from closed to wide open throttle (WOT). You should not need to use excess force. The throttle blade should move smoothly through the full range, then should independently return to a slightly open position.
- 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. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step will determine if the manifold absolute pressure (MAP) sensor voltage is within the proper range at idle.
6. This step will determine if the MAP sensor responds properly to the change in manifold pressure.
7. A throttle blade that sticks or binds may set this code. Opening the throttle through the entire range will indicate problems such as these.
9. When the PCM detects a condition within the electronic temperature control (ETC) system, other DTCs may set due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Keep this in mind when reviewing captured DTC info.

DTC P0068				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Are any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Observe the Freeze Frame/Failure Records for this DTC. 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 4	Go to Diagnostic Aids
4	Inspect for the following conditions: • Vacuum hoses for splits, kinks, and proper connections as shown on Vehicle Emission Control Information label--Inspect thoroughly for any type of leak or restriction. • Air leaks at throttle body mounting area and intake manifold sealing surfaces Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Allow the engine to reach operating temperature. 2. Observe the MAP sensor voltage parameter with a scan tool. Is the manifold absolute pressure (MAP) sensor voltage within the specified range?	0.8-2 V	Go to Step 6	Go to DTC P0106

DTC P0068				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Idle the engine. 2. Observe the MAP sensor kPa parameter with a scan tool. 3. Increase the engine speed slowly and then back to idle. Does the MAP sensor kPa change smoothly and gradually as engine speed is increased and returned to idle?	—	Go to Step 7	Go to DTC P0106
7	**CAUTION:** ***Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.*** 1. Inspect the throttle body for the following conditions while modulating the throttle through the entire range using the scan tool: • Loose or damaged throttle blade • Broken throttle shaft • Drive mechanism damage 2. If any of the above conditions exist, replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
8	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 7
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0101

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency signal based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. The PCM uses the following sensor inputs to calculate a predicted MAF value:

- The manifold absolute pressure (MAP) sensor
- The intake air temperature (IAT) sensor
- The engine coolant temperature (ECT) sensor
- The engine speed in revolutions per minute (RPM)

The PCM compares the actual MAF sensor frequency signal to the predicted MAF value. This comparison will determine if the signal is stuck based on a lack of variation, or is too low or too high for a given operating condition. If the PCM detects the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value DTC P0101 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0101 Mass Air Flow (MAF) Sensor Performance

Conditions for Running the DTC

- DTCs P0068, P0102, P0103, P0106, P0107, P0108, P0120, P0220, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P2135 are not set.
- The engine is cranking or running.
- The ignition 1 signal is between 11-18 volts.
- The throttle position (TP) indicated angle is less than 95 percent.
- The change in the TP indicated angle is less than 5 percent.
- The MAP sensor is less than 80 kPa.
- The change in the MAP sensor is less than 3 kPa.
- The above conditions are met for 1.5 seconds.
- DTC P0101 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value for more 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.

Diagnostic Aids

- Inspect the harness of the MAF sensor to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays
  - Any motors
- A low minimum air rate through the sensor bore at idle or during deceleration may cause this DTC to set. Inspect for any vacuum leak downstream of the MAF sensor.
- Inspect for any contamination or debris on the sensing elements of the MAF sensor.
- Inspect the air induction system for any water intrusion. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A wide open throttle acceleration from a stop should cause the MAF sensor parameter on the scan tool to increase rapidly. This increase should be from 3-10 g/s at idle to 170 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A high resistance of 15 ohms or more on the ignition 1 voltage circuit may cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.

- The barometric pressure (BARO) that is used to calculate the predicted mass air flow value is initially based on the MAP sensor at key ON. When the engine is running the BARO value is continually updated near wide open throttle. A skewed MAP sensor will cause the calculated mass air flow value to be inaccurate and may result in a no start condition. The value shown for the MAP sensor parameter varies with the altitude. With the ignition ON and the engine OFF, 101 kPa is the approximate value near sea level. This value will decrease by approximately 3 kPa for every 305 meters (1,000 feet) of altitude.
- A high resistance on the 5-volt reference circuit of the MAP sensor may cause this DTC to set.
- A high resistance on the low reference circuit of the MAP sensor may cause this DTC to set.
- If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step will determine if the MAP sensor pressure is within the proper range for a given altitude.
6. This step will determine if the MAP sensor voltage is within the proper range at idle.
7. This step will determine if the MAP sensor responds properly to the change in manifold pressure.
8. This step will determine if the TP sensors are operating properly.
9. This step will determine if any mechanical faults have caused this DTC to set.
10. This voltage drop test will determine if high resistance has caused this DTC to set.

DTC P0101				
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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the scan tool display any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Attempt to start the engine. Does the engine start?	—	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 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 5	Go to Diagnostic Aids

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low or very high pressure and/or temperature may cause a reading to be slightly out of range.* 1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor kPa parameter with a scan tool. 3. The manifold absolute pressure (MAP) sensor pressure should be within the specified range for your altitude. Refer to Altitude vs Barometric Pressure. Is the MAP sensor pressure within the specified range as indicated on the Altitude Vs. Barometric Pressure table?	—	Go to Step 6	Go to DTC P0106
6	1. Observe the MAP sensor parameter with a scan tool. 2. Start the engine. Does the MAP sensor parameter decrease?	—	Go to Step 7	Go to DTC P0106
7	1. Idle the engine. 2. Observe the MAP sensor parameter with a scan tool. 3. Increase the engine speed slowly to 3,000 RPM and then back to idle. Does the MAP sensor parameter change smoothly and gradually through the specified range of the test?	—	Go to Step 8	Go to DTC P0106
8	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition with the engine OFF. 3. Observe the throttle position (TP) indicated angle parameter with a scan tool. 4. Depress the accelerator pedal completely. Is the TP indicated angle parameter within the specified range?	98-100%	Go to Step 9	Go to DTC P0120

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Turn OFF the ignition. 2. Inspect for the following conditions: – A restricted or collapsed air intake duct – A misaligned air intake duct – A dirty or deteriorating air filter element – Any objects blocking the air inlet screen of the mass air flow (MAF) sensor, if equipped – Any contamination or debris on the sensing elements of the MAF sensor – Any water intrusion in the induction system – Any vacuum leak downstream of the MAF sensor – A MAF sensor wiring harness that is routed too close to any aftermarket accessories--Refer to Checking Aftermarket Accessories. – Any type of restriction in the exhaust system Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Disconnect the harness connector of the MAF sensor. 2. Measure the battery voltage with a DMM. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to Circuit Testing. 5. Connect a DMM to the probe of the test lamp and a good ground. Refer to Measuring Voltage Drop. Is the voltage within 0.50 volts of the specified value?	B+	Go to Step 11	Go to Step 12
11	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Repair the high resistance in the ignition 1 voltage circuit of the MAF sensor. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
13	Replace the MAF/intake air temperature (IAT) sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor 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 - Vehicle	System OK

DTC P0102

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency signal based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. If the PCM detects the frequency signal is less than the possible range of a correctly operating MAF sensor DTC P0102 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The engine speed is more than 400 RPM.
- The ignition 1 signal is more than 8 volts.
- The above conditions are met for more than 1 second.
- DTC P0102 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is less than 1,200 Hz for more than 0.6 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.

Diagnostic Aids

- Inspect the harness of the MAF sensor to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays
  - Any motors
- A low minimum air rate through the sensor bore at idle or during deceleration may cause this DTC to set. Inspect for any vacuum leak downstream of the MAF sensor.
- Inspect for any contamination or debris on the sensing elements of the MAF sensor.

- A wide open throttle acceleration from a stop should cause the MAF sensor parameter on the scan tool to increase rapidly. This increase should be from 3-10 g/s at idle to 170 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A high resistance of 15 ohms or more on the ground circuit of the MAF sensor may cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- A high resistance of 15 ohms or more on the ignition 1 voltage circuit can cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step will determine if any mechanical faults have caused this DTC to set.
7. This voltage drop test will determine if high resistance has caused this DTC to set.
9. This step verifies the voltage signal from the PCM to the MAF sensor connector.
10. This step tests the signal circuit of the MAF sensor for a short to another 5-volt reference circuit.
11. This step will determine if the PCM is able to process the frequency signal that it receives from the MAF sensor.
14. This step will determine which portion of the circuit or which component is shorted to ground.
17. This step verifies that the signal circuit is not shorted to any other PCM circuit.

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter less than the specified value?	1,200 Hz	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. Observe the MAF Sensor parameter with a scan tool. 2. Move the harness and the connector of the mass air flow (MAF)/intake air temperature (IAT) sensor. Does the movement of the harness or the connector affect the MAF Sensor parameter?	—	Go to Step 20	Go to Step 5

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Inspect for the following conditions: • A restricted or collapsed air intake duct • A misaligned air intake duct • A dirty or deteriorating air filter element • Any objects blocking the air inlet screen of the MAF/IAT sensor • Any water intrusion in the Induction System • Any contamination or debris on the sensing elements of the MAF sensor Did you find and correct the condition?	—	Go to Step 28	Go to Step 6
6	Inspect the fuse in the ignition 1 voltage circuit of the MAF sensor. Is the fuse open?	—	Go to Step 14	Go to Step 7
7	1. Turn ON the ignition, with the engine OFF. 2. Measure the battery voltage with a DMM. 3. Disconnect the MAF/IAT sensor. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to Probing Electrical Connectors. 5. Connect the DMM to the probe of the test lamp and a good ground. Refer to Measuring Voltage Drop and Circuit Testing. Is the voltage within 0.50 volts of the specified value?	B+	Go to Step 8	Go to Step 21

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	**IMPORTANT:** *All electrical components and accessories must be turned OFF.* 1. Turn OFF the ignition for 60 seconds to allow the control modules to power down. 2. Measure the resistance from the ground circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	5 ohms	Go to Step 9	Go to Step 22
9	1. Turn ON the ignition, with the engine OFF. 2. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 10	Go to Step 13
10	1. Connect a 3-amp fused jumper wire between the signal circuit of the MAF sensor and a good ground. Refer to Circuit Testing. **IMPORTANT:** *Running the engine with the MAF/IAT sensor disconnected may also set DTC P0113.* 2. Start the engine. 3. Observe the DTC Information with a scan tool. Do any additional DTCs set?	—	Go to Step 24	Go to Step 11

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Connect the voltage supply and ground the black lead of the J 38522 Variable Signal Generator to the vehicle. 3. Connect the red lead of the J 38522 to the signal circuit of the MAF sensor. Refer to Probing Electrical Connectors. 4. Set the Duty Cycle switch of the J 38522 to Normal. 5. Set the Frequency switch of the J 38522 to 5 K. 6. Set the Signal switch of the J 38522 to 5 V. 7. Start the engine and allow it to idle. 8. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter within the specified range?	4,950-5,025 Hz	Go to Step 12	Go to Step 15
12	**IMPORTANT:** *An abnormal resistance on the signal circuit will disable the MAF sensor frequency before the voltage starts to drop out of the correct parameter range of 4.8-5.2 volts.* 1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the MAF sensor signal circuit for a high resistance and for a short to the IAT signal circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 18
13	Is the voltage less than the specified value?	4.8 V	Go to Step 15	Go to Step 16
14	**IMPORTANT:** *The ignition 1 voltage circuit of the MAF sensor is spliced to other components of the vehicle.* Test the ignition 1 voltage circuit for a short to ground. Refer to Testing for Short to Ground and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Test the signal circuit between the PCM and the MAF sensor for the following conditions: • A high resistance • An open circuit • A short to ground Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 17
16	Important:: Disconnecting the PCM connectors may eliminate the short to voltage if the signal circuit is shorted to another PCM circuit. 1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	0 V	Go to Step 23	Go to Step 17
17	Measure the resistance from the signal circuit of the MAF sensor to all other circuits at both PCM connectors with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	∞ ohms	Go to Step 25	Go to Step 19
18	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 26

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
20	Repair the wiring or the connector as needed. Refer to Wiring Repairs and Connector Repairs. Did you complete the repair?	—	Go to Step 28	—
21	Repair the high resistance or the open in the MAF sensor ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
22	Repair the high resistance or the open in the MAF sensor ground circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
23	Repair the short to voltage in the MAF sensor signal circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
24	Repair the short between the MAF sensor signal circuit and the 5-volt reference circuit for which the DTC set. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
25	Repair the circuits that are shorted together. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
26	Replace the MAF/IAT sensor. Refer to Mass Airflow Sensor/Intake Air Temperature Sensor Replacement. Did you complete the replacement?	—	Go to Step 28	—

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 28	—
28	1. Clear the DTCs with a scan tool. Refer to Diagnostic Trouble Code (DTC) List - Vehicle. 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 29
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0103

Circuit Description

The mass air flow (MAF) sensor is an airflow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet airflow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. If the PCM detects the frequency signal is more than the possible range of a correctly operating MAF sensor DTC P0103 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The Engine Speed parameter is more than 400 RPM.
- The Ignition 1 Signal parameter is more than 8 volts.
- The above conditions are met for more than 1 second.
- DTC P0103 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is more than 13,500 Hertz for more than 1.8 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

- Inspect the air induction system for any water intrusion. The water rapidly cools the hot sensing elements in the sensor causing a false indication of excessive airflow. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A poor connection in the ignition 1 voltage circuit of the MAF sensor may cause this DTC to set.

If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

3. This step tests for electromagnetic interference (EMI) on the signal circuit of the MAF sensor. A frequency reading with the MAF sensor disconnected indicates an EMI related fault or a poor connection at the PCM. Disconnecting the MAF sensor may set additional related DTCs.
4. This step will determine if incorrect harness routing has caused this DTC to set.
5. This step will determine if water intrusion has caused this DTC to set.

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 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. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF)/intake air temperature (IAT) sensor. **IMPORTANT:** *Running the engine with the MAF/IAT sensor disconnected may set additional MAF and IAT DTCs.* 3. Start the engine. 4. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter more than the specified value?	0 Hz	Go to Step 4	Go to Step 4

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Inspect the harness of the MAF sensor for incorrect routing that is too close to the following components: – Any aftermarket accessories--Refer to Checking Aftermarket Accessories. – The secondary ignition wires or the coils – Any solenoids – Any relays – Any motors Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
5	1. Turn OFF the ignition. 2. Inspect the air induction system for any water intrusion. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	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. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0106

Diagnostic Instructions

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

DTC Descriptor

- DTC P0106: Manifold Absolute Pressure (MAP) Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
5-Volt Reference	P0101, P0107, P0522, P0641	P0106, P0107	P0107	P0101, P0106, P0108, P0522, P0641	P0106, P0107
MAP Sensor Signal	P0107	P0106, P0107	P0107	P0108	P0106, P0107
Low Reference	--	P0106, P0108	P0106, P0108	--	P0106, P0108

Typical Scan Tool Data

MAP SensorCircuit	Normal Range	Short to Ground	Open	Short to Voltage
5-Volt Reference	--	10 kPa	10 kPa	104 kPa
MAP Sensor Signal	12-103 kPa	10 kPa	10 kPa	104 kPa
Low Reference	--	--	80-103 kPa	--

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition ON, with the engine OFF, or at wide open throttle (WOT). The MAP sensor is also used to in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turn ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

The PCM calculates a predicted value for the MAP sensor based on the throttle position (TP) and the engine speed. The PCM then compares the predicted value to the actual MAP sensor signal. If the PCM detects that the MAP sensor signal is not within the predicted range, DTC P0106 sets.

Conditions for Running the DTC

- DTCs P0068, P0107, P0108, P0120, P0220, P0506, P0507, P2135 are not set.
- The engine speed is between 500-5,000 RPM.
- Any change in the engine speed is less than 125 RPM.
- The change in air flow is less than 10 g/s.
- The traction control, if equipped, is not active.
- The A/C compressor clutch state does not change.
- The clutch switch state does not change, if equipped with a manual transmission.
- The power steering load is stable.
- The brake switch state does not change.
- The above conditions are met for 1 second.
- DTC P0106 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor signal is not within the predicted range for 2 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

- The PCM 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.

Reference Information

Schematic Reference

- Engine Controls Schematics
- Connector End View Reference
  - Engine Controls Connector End Views
  - Powertrain Control Module Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Output Controls

Circuit/System Verification

IMPORTANT:
Verify that the engine is in good mechanical condition before continuing with this diagnostic.

- Verify the integrity of the air induction system by inspecting for the following conditions:
  - Any damaged components
  - Loose or improper installation
  - Improperly routed vacuum hoses
  - Any vacuum leak
  - Any type of restriction
  - A MAP sensor seal that is missing or damaged
- Verify that restrictions do not exist in the MAP sensor vacuum source.
- Verify that restrictions do not exist in the exhaust system. Refer to Restricted Exhaust.
- A skewed or stuck engine coolant temperature (ECT) or IAT sensor will cause the calculated models to be inaccurate and may cause this DTC to run when it should not. Refer to Temperature Versus Resistance.
- The BARO that is used by the PCM to calculate the air flow models is initially based on the MAP sensor at ignition ON. When the engine is running, the PCM will continually update the BARO value near wide open throttle using the MAP sensor and a calculation. A skewed MAP sensor will cause the BARO value to be inaccurate. Use the scan tool and compare the BARO parameter at ignition ON to the Altitude vs. Barometric Pressure Table. Refer to Altitude Versus Barometric Pressure.
- A skewed MAP sensor will also cause the first and second intake manifold models to disagree with the actual MAP sensor measurements. Use the scan tool and compare the MAP Sensor parameter to a known good vehicle, under various operating conditions.

- Inspect for the following conditions:
  - Incorrect cam timing--Refer to Timing Chain and Sprockets Replacement.
  - Worn piston rings--Refer to Engine Compression Test.

Circuit/System Testing

1. Turn ON the ignition, with the engine OFF.
2. Disconnect the MAP sensor.

IMPORTANT:
Certain resistances will not be detectable if a test lamp is not connected to provide a circuit load.

3. Connect a test lamp between the MAP sensor 5-volt reference circuit and a good ground.
4. Measure for a proper range of 4.8-5.2 volts between the MAP sensor 5-volt reference circuit and a good ground.
   - If the voltage is less than the specified range, then test the circuit for an open, or high resistance. If the circuit tests normal, replace the PCM.
   - If the voltage is more than the specified range, then test the circuit for a short to voltage. If the circuit tests normal, replace the PCM.
5. With the MAP sensor still disconnected, use the scan tool to observe the MAP Sensor parameter for the proper value of less than 12 kPa.
   - If the MAP Sensor parameter is more than 12 kPa, then test the MAP sensor signal circuit for a short to voltage. If the circuit tests normal, replace the PCM.
6. Connect a 3-amp jumper wire between the MAP sensor 5-volt reference circuit and the MAP sensor signal circuit.
7. Use the scan tool to observe the MAP Sensor parameter for the proper value of more than 103 kPa.
   - If the MAP Sensor parameter is less than 103 kPa, then test the MAP sensor signal circuit for high resistance. If the circuit tests normal, replace the PCM.
8. Turn OFF the ignition, and all electrical accessories. Allow sufficient time for the control module to power down before taking a resistance measurement.
9. Measure for a proper value of less than 10 ohms of resistance between the low reference circuit of the MAP sensor and a good ground.
   - If the resistance exceeds 10 ohms, test the circuit for high resistance. If the circuit tests normal, replace the PCM.
10. If the MAP sensor circuits test normal, then replace the MAP sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Manifold Absolute Pressure Sensor Replacement
- Control Module References for PCM replacement, setup, and programming

DTC P0107

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively low, DTC P0107 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0107 Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- DTCs P0068, P0120, P0220, P2135 are not set.
- The engine is running.
- The throttle angle is more than 0 percent when the engine speed is less than 800 RPM. OR
- The throttle angle is more than 12.5 percent when the engine speed is more than 800 RPM.
- DTC P0107 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is less than 0.055 volt for more 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.

DTC P0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0641 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Observe the MAP sensor parameter with the scan tool. Is the voltage is 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. 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 Testing for Intermittent Conditions and Poor Connections
5	Test for an intermittent and for a poor connection at the manifold absolute pressure (MAP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 6

DTC P0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. **IMPORTANT:** *Certain resistances will not be detectable if a test lamp is not connected to provide a circuit load.* 4. Connect a test lamp between the MAP sensor 5-volt reference circuit and a good ground. 5. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground, with a DMM. Is the voltage more than the specified value?	4.8 V	Go to Step 7	Go to Step 8
7	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the MAP sensor and the signal circuit of the MAP sensor. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to Step 11	Go to Step 9
8	Test the 5-volt reference circuit between the powertrain control module (PCM) and the MAP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	Test the MAP sensor signal circuit between the PCM and the MAP sensor for a short to ground or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
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. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12

DTC P0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0108

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively high, DTC P0108 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0108 Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Conditions for Running the DTC

- DTCs P0068, P0120, P0220, P2135 are not set.
- The engine is running.
- The minimum engine run time of 10-242 seconds is met, depending on the start-up ECT.
- The accelerator pedal angle is less than 1 percent when the engine speed is less than 1,200 RPM. OR
- The throttle angle is less than 20 percent when the engine speed is more than 1,200 RPM.

- DTC P0108 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is more than 4.9 volts for more 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.

DTC P0109				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to Step 4	Go to Step 3
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. Did the DTC fail this ignition?	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Inspect the manifold absolute pressure (MAP) sensor vacuum source for the following conditions: • A leak • A restriction • A faulty connection Did you find and correct the condition?	—	Go to Step 14	Go to Step 5
5	Monitor the DTC Information with the scan tool. Is DTC P0641 also set?	—	Go to DTC P0641Go to Step 6	Go to Step 6
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7

DTC P0109				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to Step 8	Go to Step 9
8	1. Turn OFF the ignition. 2. Connect a jumper wire between each of the terminals in the MAP sensor harness connector and the corresponding terminal at the MAP sensor. Refer to Using Connector Test Adapters. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the low reference circuit of the MAP sensor at the jumper wire terminal to a good ground with the DMM. Refer to Measuring Voltage Drop. Is the voltage more than the specified value?	0.2 V	Go to Step 10	Go to Step 12
9	Test the MAP sensor signal circuit between the powertrain control module (PCM) and the MAP sensor for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	Test the low reference circuit between the PCM and the MAP sensor for an open or for high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P0109				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0112

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively low IAT signal voltage, indicating a high temperature, DTC P0112 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0128, P0502, P0503 are not set.
- The engine run time is more than 45 seconds.
- The vehicle speed sensor (VSS) indicates that the vehicle speed is more than 40 km/h (25 mph).
- The engine coolant temperature (ECT) is less than 125°C (257°F).
- DTC P0112 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is more than 128°C (262°F) for 12.5 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

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to Temperature vs Resistance.
- If an intermittent condition is suspected, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0112				
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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the intake air temperature (IAT) sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	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 Fame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Disconnect the IAT sensor. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 6	Go to Step 5
5	Test the signal circuit of the IAT sensor for a short to ground or a short to the IAT low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	Replace the IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—

DTC P0112				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 8	—
8	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 9
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0113

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively high IAT signal voltage, indicating a low temperature, DTC P0113 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0128, P0502, P0503 are not set.
- The engine run time is more than 120 seconds.
- The vehicle speed sensor (VSS) indicates that the vehicle speed is less than 11 km/h (7 mph).
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The mass air flow (MAF) is less than 15 g/s.
- DTC P0113 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is less than -38°C (-36°F) for more than 12.5 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

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to Temperature vs Resistance.
- If a short to a separate 5-volt source occurs this DTC may set.
- If an intermittent condition is suspected, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

6. This step tests for the proper operation of the circuit in the low voltage range.

DTC P0113				
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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 4	Go to Step 3
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. Did the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Disconnect the mass air flow (MAF)/intake air temperature (IAT) sensor. 2. Connect a DMM between the signal circuit of the IAT sensor and a good ground. Is the voltage more than the specified value?	5.2 V	Go to Step 5	Go to Step 6
5	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and the low reference circuit of the IAT sensor. Refer to Using Fused Jumper Wires. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	Go to Step 10	Go to Step 7
7	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and a good ground. Refer to Using Fused Jumper Wires. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	Go to Step 9	Go to Step 8
8	Test the signal circuit of the IAT sensor for an open circuit or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	Test the IAT sensor low reference circuit for high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	Test the IAT signal circuit for a short to any 5-volt reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test for an intermittent and for a poor connection at the IAT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0116

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the signal circuit and a ground for the ECT low reference circuit. When the ECT is low, the sensor resistance is high. When the ECT is high, the sensor resistance is low. The PCM uses this high side coolant rationality test to determine if the ECT input is skewed high. The internal clock of the PCM will record the amount of time the ignition is OFF. At restart, the PCM will compare the temperature difference between the ECT and the intake air temperature (IAT). Before failing this test, the PCM will perform a calculation to determine the presence of a block heater. If the PCM detects that the temperature difference is not within the calibrated range after the ignition OFF time, DTC P0116 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0116 Engine Coolant Temperature (ECT) Sensor Performance

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P0502, P0503 are not set.
- The start-up IAT is more than -7°C (+20°F).
- The vehicle has a minimum ignition OFF time of 10 hours.
- DTC P0116 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The start-up ECT is more than the start-up IAT by 100°C (180°F). OR
- The start-up ECT is more than the start-up IAT by 15°C (27°F), then the vehicle must be driven for more than 400 seconds over 24 km/h (15 mph). If the IAT sensor temperature decreases more than 8°C (14°F), a block heater is detected and the test is aborted. If the IAT sensor temperature does not decrease, a block heater was not detected and DTC P0116 sets.

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 P0116 may set if the vehicle uses an aftermarket engine block heater.

Test Description

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

7. A snapshot is the quickest method to capture the data before it changes.
8. An IAT sensor that is skewed low can cause this DTC to set.
10. This step will determine if high resistance has caused this DTC to set.
12. A high resistance short from the signal circuit to the low reference circuit can cause this DTC to set.

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Inspect the cooling system coolant level. Is the cooling system coolant low?	—	Go to Draining and Filling Cooling System	Go to Step 3
3	Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. Did you complete the action?	—	Go to Step 4	—
4	**IMPORTANT:** *The vehicle needs to have been OFF for at least 10 hours for the engine coolant temperature (ECT) and the intake air temperature (IAT) to be at ambient temperature. The vehicle should not have changed environments during this time.* Has the engine been OFF for the specified amount of time?	10 hrs	Go to Step 7	Go to Step 5
5	1. Remove the mass air flow (MAF)/IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. 2. Remove the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. 3. Place the sensors on a work surface away from any heat source. 4. Allow the sensors to reach the ambient air temperature for 30-60 minutes. Are the sensors at the ambient temperature?	—	Go to Step 6	—

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect the MAF/IAT sensor to the electrical connector, but DO NOT install it. 2. Insulate the sensor from any engine heat source. 3. Connect the ECT sensor to the electrical connector, but DO NOT install it. 4. Insulate the sensor from any engine heat source. Are the sensors connected?	—	Go to Step 7	—
7	**IMPORTANT:** *The IAT sensor will start to warm-up as soon as the ignition is turned ON.* 1. Turn ON the ignition. 2. Take a snapshot of the Engine Data List with a scan tool. 3. Review the snapshot data that was taken with the scan tool. 4. Observe the ECT Sensor parameter with a scan tool. 5. Observe the IAT Sensor parameter with a scan tool. Is the difference between the ECT Sensor parameter and the IAT Sensor parameter more than the specified value?	15°C (27°F)	Go to Step 8	Go to Testing for Intermittent Conditions and Poor Connections
8	Observe the recorded IAT Sensor parameter. Is the difference between the IAT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to Step 9	Go to Step 10
9	Observe the recorded ECT Sensor parameter. Is the difference between the ECT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 12

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Disconnect the MAF/IAT sensor. 2. Test for an intermittent and for a poor connection at the IAT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 11
11	1. At the sensor, measure the resistance between the IAT signal and the IAT low reference terminals with a DMM and record the value. Refer to Circuit Testing. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the IAT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to Temperature vs Resistance. Is the resistance measurement of the IAT sensor within the specified range?	—	Go to Step 14	Go to Step 22
12	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: – An ECT sensor leaking engine coolant internally through the sensor – Corrosion on the ECT sensor terminals – Corrosion on the ECT harness connector terminals Did you find and correct the condition?	—	Go to Step 25	Go to Step 13
13	1. At the sensor, measure the resistance between the ECT signal and the ECT low reference terminals with a DMM and record the value. Refer to Circuit Testing. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the ECT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to Temperature vs Resistance. Is the resistance measurement of the ECT sensor within the specified range?	—	Go to Step 15	Go to Step 23

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	**IMPORTANT:** *All electrical components and accessories must be turned OFF. Performing this step will disable the diagnostic for 10 hours.* 1. Turn OFF the ignition for 90 seconds to allow the control modules to power down. 2. Measure the resistance from the low reference circuit of the IAT sensor to a good ground with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	5 ohms	Go to Step 16	Go to Step 17
15	Measure the voltage from the ECT signal circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 19
16	1. Disconnect the powertrain control module (PCM). 2. Measure the resistance of the IAT sensor signal circuit between the sensor harness and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 18
17	Test the IAT low reference circuit for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20
18	Test the IAT signal circuit for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Test the ECT signal circuit for a high resistance short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 21
20	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
21	Test for shorted terminals and poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections , and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
22	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
23	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
24	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 25	—
25	Reassemble the vehicle as necessary. Did you complete the action?	—	Go to Step 26	—

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
26	**IMPORTANT:** *This DTC will not run without the ignition being OFF for at least 10 hours.* 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 10 hours. 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 27
27	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0117

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively low ECT signal voltage, which is a high temperature indication, DTC P0117 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine run time is more than 10 seconds. OR The engine run time is less than 10 seconds when the intake air temperature (IAT) is less than 50°C (122°F).
- DTC P0117 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is more than 138°C (280°F) for more than 23 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 overheating condition may cause this DTC to set.
- After starting the engine, the ECT should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns. Refer to Temperature vs Resistance.
- If the condition is suspected of being an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0117				
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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the engine coolant temperature (ECT) sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	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. Disconnect the ECT sensor. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 6	Go to Step 5
5	Test the signal circuit of the ECT sensor for a short to ground or a short to the ECT low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 10	Go to Step
6	Test for an intermittent and for a poor connection at the ECT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7

DTC P0117				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
8	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. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0118

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The ECT sensor has a signal circuit and a low reference circuit. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively high ECT signal voltage, which is a low temperature indication, DTC P0118 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine has been running for more than 60 seconds. OR The engine run time is less than 60 seconds when the intake air temperature (IAT) is more than 0°C (32°F).
- DTC P0118 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is less than -38°C (-36°F) for 23 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

- If a short to a separate 5-volt source occurs, this DTC may set.
- After starting the engine, the ECT should rise steadily, then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table in order to test the ECT sensor. A skewed sensor could result in poor driveability conditions. Refer to Temperature vs Resistance.
- If the condition is suspected of being intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0118				
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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter less than the specified value?	-38°C (-36°F)	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. Disconnect the engine coolant temperature (ECT) sensor. 2. Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Is the voltage more than the specified value?	5.2 V	Go to Step 5	Go to Step 6
5	**IMPORTANT:** *If a short to voltage occurs, the ECT sensor may be damaged.* Test the ECT signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0118				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and the low reference circuit. Refer to Using Fused Jumper Wires. 2. Observe the ECT sensor parameter with the scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	Go to Step 10	Go to Step 7
7	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and a good ground. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	Go to Step 9	Go to Step 8
8	Test the signal circuit of the ECT sensor for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	Test the low reference circuit of the ECT sensor for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	Test the ECT signal circuit for a short to any 5-volt reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	Test for an intermittent and for a poor connection at the ECT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13

DTC P0118				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0120

Circuit Description

The throttle position (TP) sensor incorporates 2 ratiometric TP sensors into one housing. TP sensor 1 and TP sensor 2 each have a 5-volt reference circuit supplied by the throttle actuator control (TAC) module. The TAC module supplies each TP sensor with a low reference circuit. Each TP sensor supplies the TAC module with a signal voltage that is proportional to the throttle blade position. Both of the TP signal voltages increase as the throttle blade is opened. The TP sensor 1 and the accelerator pedal position (APP) sensor 1 share a 5-volt reference circuit that is bussed within the TAC module. The TP sensor 2 and the APP sensor 2 share a 5-volt reference circuit that is also bussed within the TAC module. When this DTC sets, the Reduced Engine Power indicator will be displayed.

This DTC incorporates the following diagnostic tests:

- The TP sensor 1 signal circuit voltage out of range
- The throttle blade minimum position for the TP sensor 1 out of range
- The 5-volt reference of the TP sensor 1 tests out of range

If the PCM detects one or more of the TP sensor 1 tests are out of range, DTC P0120 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0120 Throttle Position (TP) Sensor 1 Circuit

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- The TP sensor 1 signal voltage test runs continuously once the above conditions are met.
- The throttle blade minimum position for the TP sensor 1 test runs once when the ignition is turned ON and the above conditions are met.
- The 5-volt reference of the TP sensor 1 voltage test runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 1 voltage is less than 0.38 volts or more than 4.5 volts for more than 0.1 second.

  OR
- The TP sensor 1 minimum throttle blade position is less than 0.38 volts or more than 0.71 volts for less than 1 second.

  OR
- The 5-volt reference circuit of the TP sensor 1 is shorted to ground for more than 0.01 second.

  OR
- The 5-volt reference circuit of the TP sensor 1 is less than 4.54 volts or more than 5.21 volts for more 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 this occurs, multiple DTCs could be set with no 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 stored information, Capture Info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

33. 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 stored information, Capture Info.

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect the jumper wires between the throttle position (TP) sensor 1 terminals of the throttle body harness connector and the corresponding TP sensor 1 terminals of the throttle body. 5. Turn ON the ignition, with the engine OFF. 6. Close the throttle blade by hand. 7. Observe the TP sensor 1 voltage with a scan tool. Is the TP sensor 1 voltage within the specified range?	0.38-0.71 V	Go to Step 5	Go to Step 3
3	1. Turn OFF the ignition. 2. Connect jumper wires between the TP sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body. 3. Turn ON the ignition, with the engine OFF. 4. Close the throttle blade by hand. 5. Observe the TP sensor 2 voltage with a scan tool. Is the TP sensor 2 voltage within the specified range?	0.28-0.81 V	Go to Step 9	Go to Step 4
4	Is DTC U0107 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 9
5	1. Open the throttle blade to wide open throttle (WOT) by hand. 2. Observe the TP sensor 1 voltage parameter on the scan tool. Is the TP sensor 1 voltage parameter more than the specified value?	4.5 V	Go to Step 9	Go to Step 6

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 7
7	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to Connector Repairs and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 8
8	1. Continue to observe the DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 27	Go to Diagnostic Aids
9	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 1 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to Step 14	Go to Step 10

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	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 1 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 11
11	Test the TP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 12
12	Test the TP sensor 1 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 13
13	1. Disconnect the other TAC module harness connector. 2. Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 28
14	Measure the voltage from the TP sensor 1 5-volt reference circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.54-5.21 V	Go to Step 24	Go to Step 15
15	Is the voltage more than the specified value?	5.21 V	Go to Step 16	Go to Step 18

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	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 1 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 17
17	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 1 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 22
18	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to Step 19	Go to Step 30
19	1. Disconnect the TAC module harness connector containing the TP sensor circuits. 2. Test the TP sensor 1 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 20
20	Test the TP sensor 1 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	—	Go to Step 32	Go to Step 21

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Test the APP sensor 1 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 22
22	Test for a short between the TP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 32	Go to Step 23
23	Test for a short between the APP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 28
24	1. Connect a fused jumper between the TP sensor 1 low-reference circuit and the TP sensor 1 signal circuit. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Is the TP sensor 1 parameter near the specified value?	0 V	Go to Step 26	Go to Step 25
25	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 28
26	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 29

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 30
28	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 31
29	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 32	—
30	Replace the APP sensor. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 32	—
31	Replace the TAC module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 32	—
32	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 33

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
33	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0128

Circuit Description

An engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the powertrain control module (PCM) for engine control, and as an enabling criteria for some diagnostics.

The air flow coming into the engine is accumulated and used to determine if the vehicle has been driven within conditions that would allow the engine coolant to heat up normally to the thermostat regulating temperature. If the coolant temperature does not increase normally or does not reach the regulating temperature of the thermostat, diagnostics that use ECT as enabling criteria may not run when expected.

This DTC will only run once per ignition cycle within the enabling condition. If the PCM detects the calibrated amount of air flow and engine run time have been met and the ECT has not met the minimum thermostat regulating temperature, DTC P0128 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0128 Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0220, P0502, P0503, P2135 are not present.
- The start-up ECT is less than 70°C (158°F) when the intake air temperature (IAT) is more than 10°C (50°F).

  OR

  The start-up ECT is less than 50°C (122°F) when the IAT is between -7 and +10°C (+19 and +50°F).
- The fuel ethanol is less than 85 percent.
- The IAT sensor parameter is between -7 and +55°C (+19 and +131°F).
- The engine run time is between 90-1,370 seconds.
- The vehicle speed is more than 8 km/h (5 mph) for more than 2.5 km (1.5 miles).
- The mass air flow (MAF) is between 20-75 g/s with the average more than 10 g/s.
- DTC P0128 runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The PCM detects all of the following conditions:

- The calibrated amount of engine run time has been met.
- The calibrated amount of engine air flow has been met.
- The calibrated vehicle speed and distance have been met.
- The calibrated minimum ECT of 75°C (167°F) has not been met when the IAT is more than 10°C (50°F).

  OR

  The calibrated minimum ECT of 55°C (131°F) has not been met when the IAT is between -7 and +10°C (+19 and +50°F).

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 P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *The cooling fans are commanded ON when certain engine coolant temperature (ECT) DTCs are set.* Is the cooling system coolant low?	—	Go to Draining and Filling Cooling System	Go to Step 3
3	Test and verify the proper operation of the thermostat. Refer to Thermostat Diagnosis. Did you find and correct the condition?	—	Go to Step 14	Go to Step 4
4	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: • Corrosion on the ECT sensor terminals • Improper or corroded terminals at the ECT harness connector • Loose terminals in the ECT harness connector--Refer to Testing for Intermittent Conditions and Poor Connections. Did you find and correct the condition?	—	Go to Step 14	Go to Step 5
5	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. Did you find and correct the condition?	—	Go to Step 14	Go to Step 6
6	Measure the resistance of the ECT sensor signal circuit between the sensor and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Step 7	Go to Step 10

DTC P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Measure the resistance of the ECT sensor low reference circuit between the sensor and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Step 8	Go to Step 11
8	1. Turn OFF the ignition. 2. Remove the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement. 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to Temperature Versus Resistance. Is the resistance measurement of the ECT sensor within the specified range?	—	Go to Step 9	Go to Step 12
9	Install the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement. Is the action complete?	—	Go to Step 13	—
10	Repair the high resistance in the ECT sensor signal circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
11	Repair the high resistance in the ECT sensor low reference circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—

DTC P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—
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 15
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 - Vehicle	System OK

DTC P0131 or P0151

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The PCM supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0131 sets for HO2S bank 1 sensor 1, or DTC P0151 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0131 HO2S Circuit Low Voltage Bank 1 Sensor 1
- DTC P0151 HO2S Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol Content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.

- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is less than 200 mV for 165 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.
- The control module commands the Loop Status open.

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 the voltage is varying above and below the specified range, the condition is not present.

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 7	Go to Step 8

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 9
7	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
8	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	Test the HO2S high signal circuit for a short to the following circuits: • The HO2S low signal circuit • The HO2S heater low control circuit Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0131 or P0151				
Step	Action	Value(s)	Yes	No
10	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* – A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass?	—	Go to Step 17	Go to DTC P0420 or P0430
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 - Vehicle	System OK

DTC P0132 or P0152

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0132 sets for HO2S bank 1 sensor 1, or DTC P0152 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0132 HO2S Circuit High Voltage Bank 1 Sensor 1
- DTC P0152 HO2S Circuit High Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol Content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.

- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is greater than 1050 mV for 48 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.
- The control module commands the Loop Status open.

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 the voltage is varying above and below the specified range, the condition is not present.

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter within the specified range?	400-500 mV	Go to Step 5	Go to Step 6
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 7	Go to Step 8

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the HO2S high signal circuit for a short to the HO2S heater low control circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
7	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 9	Go to Step 11
8	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
9	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 12

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	1. The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – Engine oil contaminated with fuel – An evaporative emission (EVAP) canister purge condition – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any rich fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – An air intake restriction or collapsed air intake duct 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass?	—	Go to Step 19	Go to DTC P0420 or P0430

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0133 or P0153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from greater than 625 mV to less than 250 mV or from less than 250 mV to greater than 625 mV. If the PCM detects that the transition time is too long, DTC P0133 sets for HO2S bank 1 sensor 1 or DTC P0153 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0133 HO2S Slow Response Bank 1 Sensor 1
- DTC P0153 HO2S Slow Response Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is greater than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.

- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for one second.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S rich-to-lean or lean-to-rich average response time is more than a calibrated value for 100 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 the voltage is varying above and below the specified value, the condition is not present.

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P0133 or P0153				
Step	Action	Value(s)	Yes	No
5	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
6	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step 7
7	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant. Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0134 or P0154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0134 sets for HO2S bank 1 sensor 1 or DTC P0154 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0134 HO2S Circuit Insufficient Activity Bank 1 Sensor 1
- DTC P0154 HO2S Circuit Insufficient Activity Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Engine Run Time parameter is more than 300 seconds.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is between 350-550 mV for 60 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.
- The control module commands the Loop Status open.

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.

3. If the voltage is varying above and below the specified value, the condition is not present.

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to Step 3	Go to DTC P0135 or P0155
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	Go to Step 4	Go to Step 5

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	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 5	Go to Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 6
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	0.2 V	Go to Step 8	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 12	Go to Step 10
9	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 13	Go to Step 11
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0134 or P0154				
Step	Action	Value(s)	Yes	No
12	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 17	—

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0135 or P0155

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater current is not within an expected range, DTC P0135 sets for HO2S bank 1 sensor 1, or DTC P0155 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0135 HO2S Heater Performance Bank 1 Sensor 1
- DTC P0155 HO2S Heater Performance Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0053, P0059, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is greater than 50°C (122°F).
- The Fuel Alcohol content parameter is less than 90 percent.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 300 seconds.

- The above conditions are met for 2 seconds.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S Heater current parameter is greater than 3.125 amps or less than 0.25 amps.
- The above condition is met for 10 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0135 or P0155				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A fuse. Is the O2A fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0135 or P0155				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	Important: Perform the following test on all HO2S' which are supplied voltage by the suspect circuit. Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0135 or P0155				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0135 or P0155				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	Were you sent to this diagnostic from DTC P0134 or P0154?	—	Go to DTC P0134 or P0154	Go to Step 21
21	1. Replace the O2A fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 22
22	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0136 or P0156

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream.

The HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 are used for catalyst monitoring. This diagnostic runs once per ignition cycle. This diagnostic consists of two tests, a passive test and an intrusive test. During the passive test, if the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 voltage transitions less than 349 mV and greater than 710 mV, the DTC will pass for this ignition cycle. If the DTC does not pass during the passive test, the intrusive test will begin. During the intrusive test, the control module will force the air-to-fuel ratio rich and/or lean. The control module then waits for a predicted response from the HO2S. If the HO2S voltage transitions less than 349 mV or greater than 710 mV, the DTC will pass for this ignition cycle. If the control module does not receive the expected response from the HO2S, DTC P0136 will set for HO2S bank 1 sensor 2 or DTC P0156 will set for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0136 HO2S Performance Bank 1 Sensor 2
- DTC P0156 HO2S Performance Bank 2 Sensor 2

Conditions for Running the DTC

DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1134, P1153, P1154 are not set.

PASSIVE TEST

- The engine is running.
- The Engine Run Time parameter is less than 13.5 minutes.
- The above conditions are met for 2 seconds.
- This diagnostic runs one time per drive cycle once the above conditions are met.

INTRUSIVE TEST

- The Engine Run Time parameter is more than 13.5 minutes.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Engine Speed parameter is between 900-5,000 RPM.
- The MAF Sensor parameter is between 5-55 g/s.
- The Vehicle Speed parameter is between 24-131 km/h (15-82 mph).
- The Short Term FT Bank 1 and Bank 2 parameter is between -10 and +10 percent.
- The maximum number of intrusive attempts is less than 100.
- The above conditions are met for one second.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

1. The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 did not transition less than 349 mV and greater than 710 mV during the passive test.
2. One of the following tests fail:

LEAN INTRUSIVE TEST

- The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is greater than 349 mV for 25.4 seconds.
- The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is less than 300 mV.

RICH INTRUSIVE TEST

- The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is less than 710 mV for 25.4 seconds.
- The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is greater than 600 mV.

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. If the voltage does not change more than the specified value, the condition is present.

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 8

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 10	Go to Step 11
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 14
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 15	Go to Step 13
13	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
15	1. The HO2S may be detecting a rich exhaust condition, a lean exhaust condition, or the HO2S may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – Engine oil contaminated with fuel – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean or rich fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	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 21

DTC P0136 or P0156				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0137 or P0157

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The PCM supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0137 sets for HO2S bank 1 sensor 2, or DTC P0157 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0137 HO2S Circuit Low Voltage Bank 1 Sensor 2
- DTC P0157 HO2S Circuit Low Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.

- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is less than 80 mV for 200 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 the voltage does not change more that the specified value, the condition is present.

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from less than 300 mV to greater than 600 mV. If the voltage is not varying, refer to DTC P0132 or P0152.* 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor Connections

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 8
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 10	Go to Step 11

DTC P0137 or P0157				
Step	Action	Value(s)	Yes	No
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
10	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 14
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 15	Go to Step 13

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
14	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
15	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* – A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	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 21

DTC P0137 or P0157				
Step	Action	Value(s)	Yes	No
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0138 or P0158

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0138 sets for HO2S bank 1 sensor 2, or DTC P0158 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0138 HO2S Circuit High Voltage Bank 1 Sensor 2
- DTC P0158 HO2S Circuit High Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.

- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is greater than 950 mV for 200 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 the voltage does not change more that the specified value, the condition is present.

DTC P138 or P0158				
Step	Action	Value(s)	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from less than 300 mV to greater than 600 mV. If the voltage is not varying, refer to DTC P0131 or P0151.* 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor Connections

DTC P138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 6	Go to Step 5
5	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 7	Go to Step 8
6	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
7	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 9	Go to Step 11
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 10
10	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
11	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P138 or P0158				
Step	Action	Value(s)	Yes	No
12	1. The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – Engine oil contaminated with fuel – An evaporative emission (EVAP) canister purge condition – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any rich fuel injectors--Refer to Fuel Injector Balance Test with Tech – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – An air intake restriction or collapsed air intake duct 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

DTC P138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Replace the affected HO2S. 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 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0140 or P0160

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0140 sets for HO2S bank 1 sensor 2, or DTC P0160 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0140 HO2S Circuit Insufficient Activity Bank 1 Sensor 2
- DTC P0160 HO2S Circuit Insufficient Activity Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0054, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0141, P0161, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Engine Run Time parameter is more than 300 seconds.
- The Loop Status is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S voltage parameter is between 410-490 mV for 150 seconds.
- The TP Indicated Angle parameter changes more than 5 percent within 1 second, 6 times.

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.

3. If the voltage is varying above and below the specified value, the condition is not present.

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to Step 3	Go to DTC P0141 or P0161
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to Step 4	Go to Step 5

DTC P0140 or P0160				
Step	Action	Value(s)	Yes	No
4	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 5	Go to Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 6
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	0.2 V	Go to Step 8	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 12	Go to Step 10
9	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 13	Go to Step 11
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0140 or P0160				
Step	Action	Value(s)	Yes	No
12	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. 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 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 17	—

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0141 or P0161 (w/4.8L)

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater current is not within an expected range, DTC P0141 sets for HO2S bank 1 sensor 2, or DTC P0161 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0141 HO2S Heater Performance Bank 1 Sensor 2
- DTC P0161 HO2S Heater Performance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0054, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is greater than 50°C (122°F).
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 300 seconds.

- The above conditions are met for 2 seconds.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S Heater current parameter is greater than 1.625 amps or less than 0.25 amp.
- The above condition is met for 10 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0141 or P0161 (w/ 4.8L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.625 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2B fuse. Is the O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0141 or P0161 (w/ 4.8L Engine)				
Step	Action	Value(s)	Yes	No
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0141 or P0161 (w/ 4.8L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0141 or P0161 (w/ 4.8L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	Were you sent to this diagnostic from DTC P0140 or P0160?	—	Go to DTC P0140 or P0160	Go to Step 21
21	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 22
22	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0141 or P0161 (w/6.0L)

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater current is not within an expected range, DTC P0141 sets for HO2S bank 1 sensor 2, or DTC P0161 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0141 HO2S Heater Performance Bank 1 Sensor 2
- DTC P0161 HO2S Heater Performance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0054, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is greater than 50°C (122°F).
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 300 seconds.

- The above conditions are met for 2 seconds.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S Heater current parameter is greater than 1.375 amps or less than 0.25 amp.
- The above condition is met for 10 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0141 or P0161 (w/ 6.0L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.375 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2B fuse. Is the O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0141 or P0161 (w/ 6.0L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0141 or P0161 (w/ 6.0L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0141 or P0161 (w/ 6.0L Engine)				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	Were you sent to this diagnostic from DTC P0140 or P0160?	—	Go to DTC P0140 or P0160	Go to Step 21
21	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 22
22	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0171 or P0174

Diagnostic Instructions

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

DTC Descriptors

DTC P0171: Fuel Trim System Lean Bank 1

DTC P0174: Fuel Trim System Lean Bank 2

Circuit/System Description

The engine control module (ECM) 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 Loop and Closed Loop (CL). During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During CL, the ECM adds HO2S inputs and level of purge to calculate the short and long term fuel trim (FT) adjustments. If the HO2S indicates a lean condition, the fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, the FT values will be below 0 percent. The short term FT values change rapidly in response to the HO2S voltage signals. The long term FT makes coarse adjustments in order to maintain an optimum air/fuel ratio. A block of cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term FT diagnostic is based on an average of cells currently being used. The ECM selects the cells based on the engine speed and load. The FT 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 ECM detects an excessively lean condition, DTC P0171 or P0174 sets.

Conditions for Running the DTC

- DTCs P0030, P0036, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0117, P0118, P0120, P0121, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0201-P0208, P0220, P0300, P0301-P0304, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P1106, P1107, P1114, P1115, P1133, P1516, P2101, P2119, P2120, P2125, P2135, P2138, P2176 are not set.
- The engine is in Closed Loop status.
- The engine coolant temperature (ECT) is between -40 and +139°C (-40 and +282°F).
- The intake air temperature (IAT) is between -20 and +152°C (-4 and +304°F).
- The manifold absolute pressure (MAP) is between 15-105 kPa (2.2-15.2 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 400-6,500 RPM.
- The mass air flow (MAF) is between 1-250 g/s.
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The fuel level is more than 15 percent.
- This diagnostic runs continuously when the above conditions have been met.

Conditions for Setting the DTC

- The average long term FT weighted average value is more or less than a calibrated value.
- The above condition is present for approximately 3 minutes after the conditions for running the DTC have been met.

Action Taken When the DTC Sets

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 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. The control module illuminates the malfunction indicator lamp (MIL) when one of the following occur:

- The control module detects the same fuel trim failure during 2 consecutive trips.

- The control module detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
  - The engine load is within 20 percent of the previous test that failed.
  - The engine speed is within 375 RPM of the previous test that failed.
  - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 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 and related Freeze Frame data clears after 40 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.

Reference Information

Electrical Information Reference

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

Emission System Information Reference

- Evaporative Emissions Hose Routing Diagram
- Crankcase Ventilation System Inspection/Diagnosis

Engine Mechanical Information Reference

- Symptoms - Engine Mechanical
- Symptoms - Engine Exhaust

Fuel System Information Reference

- Fuel System Diagnosis
- Alcohol/Contaminants-in-Fuel Diagnosis

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

IMPORTANT:
Disregard any transmission symptoms, antilock brake system (ABS) indicators, and traction control system (TCS) indicators until any fuel trim faults are repaired. A fuel trim fault may cause default actions such as harsh shifts and illumination of the ABS/TCS indicators.

- Verify that other DTCs are not set.
- If any DTCs are set, refer to Diagnostic Trouble Code (DTC) List - Vehicle.
- Allow the engine to reach operating temperature. With the engine running, observe the HO2S parameter with a scan tool. The HO2S value should vary from approximately 40 mV to approximately 900 mV, and respond to fueling changes.
- If the value does not vary from approximately 40 mV to approximately 900 mV, refer to DTC P0131 or P0151, DTC P0133 or P0153, DTC P0134 or P0154, DTC P0137 or P0157, DTC P0140 or P0160, DTC P1133 or P1153, or DTC P2A01 or P2A04.

IMPORTANT:
EVAP purge enablement may cause the FT to be momentarily outside the normal range.

- The normal Short Term FT parameter should be between +10 percent and -10 percent, with near 0 percent the optimum, with the engine running at operating temperature.
- The Long Term FT parameter should be between +10 percent and -10 percent, with near 0 percent the optimum, with the engine running at operating temperature.

Circuit/System Testing

Allow the engine to reach operating temperature. With the engine running, observe the affected Long Term FT parameter with a scan tool. The value should be less than approximately 20 percent with the engine running at operating temperature.

- If the value is not less than 20 percent, inspect for the following:
  - With the ignition ON and the engine OFF, observe the manifold absolute pressure (MAP) sensor parameter. The MAP sensor pressure should be within the range specified for your altitude. Refer to Altitude Versus Barometric Pressure.
    - Refer to DTC P0106 if the MAP sensor does not indicate the correct barometric pressure.
  - With the engine idling, observe the mass air flow (MAF) sensor parameter. The MAF sensor parameter should be within 2-6 g/s at idle.
    - Refer to DTC P0101 , DTC P0102 , or DTC P0103 if the MAF sensor parameter is not within 2-6 g/s at idle.
  - Vacuum hoses for splits, kinks, and improper connections
  - Insufficient fuel in the tank
  - Low fuel pressure
  - Fuel contamination
  - Malfunctioning fuel injectors
  - Missing, loose, or leaking exhaust components from the HO2S forward
  - Vacuum leaks at the intake manifold, the throttle body, and the injector O-rings
  - The air induction system and the air intake ducts for leaks or for a missing air filter element
  - A cracked EVAP canister
  - Evaporative pipes obstructed or leaking
  - The crankcase ventilation system for leaks
  - The HO2S for improper installation and for electrical wires or connectors that may have contacted the exhaust system
  - The HO2S signal circuit open, shorted to ground, or shorted to the low reference circuit
  - Malfunctioning engine components

Repair Instructions

- Evaporative Emission Canister Replacement
- Evaporative Emission Canister Purge Solenoid Valve Replacement
- Evaporative Emission Hoses/Pipes Replacement - Engine
- Fuel Injector Replacement
- Fuel System Cleaning
- Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 , Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 , Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 , or Heated Oxygen Sensor Replacement - Bank 2 Sensor 2
- Manifold Absolute Pressure Sensor Replacement
- Mass Airflow Sensor/Intake Air Temperature Sensor Replacement
- Throttle Body Assembly Replacement

Repair Verification

IMPORTANT:

- After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.
- To verify the performance of the catalytic converter has not been affected by the condition that set this DTC, perform the Repair Verification for DTC P0420 or P0430. Refer to DTC P0420 or P0430.

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.

3. Turn ON the ignition, with the engine OFF.

IMPORTANT:
DO NOT clear codes with the engine running. The codes may reset in the same ignition cycle.

4. Clear the DTCs.
5. Turn OFF the ignition for 60 seconds.
6. Start the engine.
7. Duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets, or another DTC is present, refer to the Diagnostic Trouble Code (DTC) List - Vehicle and perform the appropriate diagnostic procedure.

DTC P0172 or P0175

Diagnostic Instructions

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

DTC Descriptors

DTC P0172: Fuel Trim System Rich Bank 1

DTC P0175: Fuel Trim System Rich Bank 2

Circuit/System Description

The engine control module (ECM) 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 Loop and Closed Loop (CL). During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During CL, the ECM adds HO2S inputs and level of purge to calculate the short and long term fuel trim (FT) adjustments. If the HO2S indicates a lean condition, the fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, the FT values will be below 0 percent. The short term FT values change rapidly in response to the HO2S voltage signals. The long term FT makes coarse adjustments in order to maintain an optimum air/fuel ratio. A block of cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term FT diagnostic is based on an average of cells currently being used. The ECM selects the cells based on the engine speed and load. The FT 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.

For E85 compatible engines only--Over estimation of the ethanol content will result in a rich shift of fuel trim values, and under estimation will result in a lean shift of fuel trim values. A fuel trim DTC may set if the learned alcohol content, Fuel Alcohol Content parameter on the scan tool, is different than the measured alcohol content in the vehicle such that the fuel trim values exceed failure threshold values.

If the ECM detects an excessively rich condition, DTC P0172 or P0175 sets.

Conditions for Running the DTC

- DTCs P0030, P0036, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0117, P0118, P0120, P0121, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0201-P0208, P0220, P0300, P0301-P0304, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P1106, P1107, P1114, P1115, P1133, P1516, P2101, P2119, P2120, P2125, P2135, P2138, P2176 are not set.
- The engine is in Closed Loop status.
- The engine coolant temperature (ECT) is between -40 and +139°C (-40 and +282°F).
- The intake air temperature (IAT) is between -20 and +152°C (-4 and +304°F).
- The manifold absolute pressure (MAP) is between 15-105 kPa (2.2-15.2 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 400-6,500 RPM.
- The mass air flow (MAF) is between 1-250 g/s.
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The fuel level is more than 15 percent.
- This diagnostic runs continuously when the above conditions have been met.

Conditions for Setting the DTC

- The average long term FT weighted average value is more or less than a calibrated value.
- The above condition is present for approximately 3 minutes after the conditions for running the DTC have been met.

Action Taken When the DTC Sets

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 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. The control module illuminates the malfunction indicator lamp (MIL) when one of the following occur:

- The control module detects the same fuel trim failure during 2 consecutive trips.

- The control module detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
  - The engine load is within 20 percent of the previous test that failed.
  - The engine speed is within 375 RPM of the previous test that failed.
  - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 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 and related Freeze Frame data clears after 40 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.

Reference Information

Electrical Information Reference

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

Emission System Information Reference

- Evaporative Emissions Hose Routing Diagram
- Crankcase Ventilation System Inspection/Diagnosis

Engine Mechanical Information Reference

- Symptoms - Engine Mechanical
- Symptoms - Engine Exhaust

Fuel System Information Reference

- Fuel System Diagnosis
- Alcohol/Contaminants-in-Fuel Diagnosis

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

IMPORTANT:
Disregard any transmission symptoms, antilock brake system (ABS) indicators, and traction control system (TCS) indicators until any fuel trim faults are repaired. A fuel trim fault may cause default actions such as harsh shifts and illumination of the ABS/TCS indicators.

- Verify that other DTCs are not set.
  - If any DTCs are set, refer to Diagnostic Trouble Code (DTC) List - Vehicle.
- Allow the engine to reach operating temperature. With the engine running, observe the HO2S parameter with a scan tool. The HO2S value should vary from approximately 40 mV to approximately 900 mV, and respond to fueling changes.
  - If the value does not vary from approximately 40 mV to approximately 900 mV, refer to DTC P0132 or P0152 , DTC P0133 or P0153 , DTC P0134 or P0154 , DTC P0138 or P0158 , DTC P0140 or P0160 , DTC P1133 or P1153 , or DTC P2A01 or P2A04.

IMPORTANT:
EVAP purge enablement may cause the FT to be momentarily outside the normal range.

- The normal Short Term FT parameter should be between +10 percent and -10 percent, with near 0 percent the optimum, with the engine running at operating temperature.
- The Long Term FT parameter should be between +10 percent and -10 percent, with near 0 percent the optimum, with the engine running at operating temperature.

Circuit/System Testing

Allow the engine to reach operating temperature. With the engine running, observe the affected Long Term FT parameter with a scan tool. The value should be more than approximately -20 percent with the engine running at operating temperature.

- If the value is not more than -20 percent, inspect for the following:
  - With the engine idling and the transmission in the Park or Neutral position, observe the manifold absolute pressure (MAP) sensor parameter. The MAP sensor parameter should be between 19-42 kPa.
    - Refer to DTC P0106 if the MAP sensor parameter is not between 19-42 kPa.
- With the engine idling, observe the mass air flow (MAF) sensor parameter. The MAF sensor parameter should be within 2-6 g/s at idle.
  - Refer to DTC P0101 , DTC P0102 , or DTC P0103 if the MAF sensor parameter is not within 2-6 g/s at idle.
- Vacuum hoses for splits, kinks, and improper connections
- The air intake duct for being collapsed or restricted
- The air filter for being dirty or restricted
- Objects blocking the throttle body
- Excessive fuel in the crankcase due to leaking fuel injectors
- The evaporative emissions control system for improper operation
- Excessive fuel pressure
- Malfunctioning fuel injectors
- Fuel contamination
- The HO2S for improper installation and for electrical wires or connectors that may have contacted the exhaust system
- The HO2S signal circuit shorted to voltage

Repair Instructions

- Evaporative Emission Canister Replacement
- Evaporative Emission Canister Purge Solenoid Valve Replacement
- Evaporative Emission Hoses/Pipes Replacement - Engine
- Fuel Injector Replacement
- Fuel System Cleaning
- Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 , Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 , Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 , or Heated Oxygen Sensor Replacement - Bank 2 Sensor 2
- Manifold Absolute Pressure Sensor Replacement
- Mass Airflow Sensor/Intake Air Temperature Sensor Replacement
- Throttle Body Assembly Replacement

Repair Verification

IMPORTANT:

- After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.
- To verify the performance of the catalytic converter has not been affected by the condition that set this DTC, perform the Repair Verification for DTC P0420 or P0430. Refer to DTC P0420 or P0430.

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Turn ON the ignition, with the engine OFF.

IMPORTANT:
DO NOT clear codes with the engine running. The codes may reset in the same ignition cycle.

4. Clear the DTCs.

5. Turn OFF the ignition for 60 seconds.
6. Start the engine.
7. Duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets, or another DTC is present, refer to the Diagnostic Trouble Code (DTC) List - Vehicle and perform the appropriate diagnostic procedure.

DTC P0200

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. The control module monitors the status of each driver. If the control module detects an incorrect voltage for the commanded state of the driver, DTC P0200 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0200 Injector Control Circuit

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 Testing for Intermittent Conditions and Poor Connections.

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

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 13
5	1. Connect the J 34730-405 Injector Test Lamp between the control circuit of the fuel injector and the ignition voltage circuit of the fuel injector. 2. Start the engine. Does the test lamp flash?	—	Go to Step 6	Go to Step 7

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Did the DTC fail this ignition?	—	Go to Step 12	Go to Step 10
7	Does the test lamp remain illuminated?	—	Go to Step 9	Go to Step 8
8	Test the fuel injector control circuit for a short to voltage or for an open. Refer to Circuit Testing and Wiring Repairs.	—	Go to Step 16	Go to Step 12
9	Test the fuel injector control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. 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 fuel injector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 16	Go to Step 11
11	1. Apply Dielectric compound GM P/N 12377900 (Canadian P/N 10953529) to the fuel injector electrical connector. 2. Reconnect the fuel injector connector. 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 14	Go to Step 16
12	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 Repairing Connector Terminals. Did you find and correct the condition?.	—	Go to Step 16	Go to Step 15

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	**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.* Repair the open or short to ground in the ignition 1 voltage circuit of the fuel injector. Is the repair complete?	—	Go to Step 16	—
14	Replace the fuel injector. Refer to Fuel Injector Replacement. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. Did 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 - Vehicle	System OK

DTC P0220

Circuit Description

The throttle position (TP) sensor incorporates 2 ratiometric TP sensors into one housing. TP sensor 1 and TP sensor 2 each have a 5-volt reference circuit supplied by the throttle actuator control (TAC) module. The TAC module supplies each TP sensor with a low reference circuit. Each TP sensor supplies the TAC module with a signal voltage that is proportional to the throttle blade position. Both TP signal voltages increase as the throttle blade is opened. The TP sensor 1 and the accelerator pedal position (APP) sensor 1 share a 5-volt reference circuit that is bussed within the TAC module. The TP sensor 2 and the APP sensor 2 share a 5-volt reference circuit that is also bussed within the TAC module. When this DTC sets, the Reduced Engine Power indicator will be displayed.

This DTC incorporates the following diagnostic tests:

- The TP sensor 2 signal circuit voltage out of range
- The throttle blade minimum position for the TP sensor 2 out of range
- The 5-volt reference of the TP sensor 2 tests out of range.

If the PCM detects one or more of the TP sensor 2 tests are out of range, DTC P0220 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0220 Throttle Position (TP) Sensor 2 Circuit

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- The TP sensor 2 signal voltage test runs continuously once the above conditions are met.
- The throttle blade minimum position for the TP sensor 2 test runs once when the ignition is turned ON and the above conditions are met.
- The 5-volt reference of the TP sensor 2 voltage test runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 2 signal voltage is less than 0.28 volts, or more than 4.6 volts, for more than 0.1 second.
  OR
- The TP sensor 2 minimum throttle blade position is less than 0.28 volts, or more than 0.81 volts, for less than 1 second.
  OR
- The 5-volt reference circuit of the TP sensor 2 is less than 0.5 volts for more than 0.01 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

31. 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 stored information, Capture Info.

DTC P220				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect jumper wires between the throttle position (TP) sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body. 5. Turn ON the ignition, with the engine OFF. 6. Close the throttle blade by hand. 7. Observe the TP sensor 2 voltage with a scan tool. Is the TP sensor 2 voltage within the specified range?	0.28-0.81 V	Go to Step 3	Go to Step 7
3	1. Open the throttle blade to wide open throttle (WOT) by hand. 2. Observe the TP sensor 2 voltage parameter on the scan tool. Is the TP sensor 2 voltage parameter more than the specified value?	4.6 V	Go to Step 7	Go to Step 4
4	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 5

DTC P220				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to Connector Repairs and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 6
6	1. Continue to observe the DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 25	Go to Diagnostic Aids
7	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 2 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to Step 12	Go to Step 8
8	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 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 9

DTC P220				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the TP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 10
10	Test the TP sensor 2 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 11
11	1. Disconnect the other TAC module harness connector. 2. 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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
12	Measure the voltage from the TP sensor 2 5-volt reference circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.54-5.21 V	Go to Step 22	Go to Step 13
13	Is the voltage more than the specified value?	5.21 V	Go to Step 14	Go to Step 16
14	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 15

DTC P220

Step	Action	Value(s)	Yes	No
15	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 2 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 20
16	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to Step 17	Go to Step 28
17	1. Disconnect the TAC module harness connector containing the TP sensor circuits. 2. Test the TP sensor 2 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 18
18	Test the TP sensor 2 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	—	Go to Step 30	Go to Step 19
19	Test the APP sensor 2 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 20
20	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 21

DTC P220				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
22	1. Connect a fused jumper between the TP sensor 2 low-reference circuit and the TP sensor 2 signal circuit. 2. Observe the TP sensor 2 voltage parameter with a scan tool. Is the TP sensor 2 parameter near the specified value?	—	Go to Step 30	Go to Step 23
23	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 2 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
24	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 27
25	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 27
26	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29

DTC P220				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 30	—
28	Replace the APP sensor. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 30	—
29	Replace the TAC module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 30	—
30	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 31
31	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0230

Circuit Description

The control module enables the fuel pump relay when the ignition switch is turned ON. The control module will disable the fuel pump relay within 2 seconds unless the control module detects ignition reference pulses. The control module continues to enable the fuel pump relay as long as ignition reference pulses are detected. The control module disables the fuel pump relay within 2 seconds if ignition reference pulses cease to be detected and the ignition remains ON.

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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0230 Fuel Pump Relay Control Circuit

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

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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.

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 P230				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. 5. Command the fuel pump 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

DTC P230				
Step	**Action**	**Value(s)**	**Yes**	**No**
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. 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. 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. 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 powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. 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. 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	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—

DTC P230				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0300 Engine Misfire Detected

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0125, P0128, P0220, P0315, P0335, P0336, P0341, P0342, P0343, P0502, P0503, P1114, P1115, P1120, P1258 are not set.
- The engine speed is between 450-5,000 RPM.
- The ignition voltage is between 10-18 volts.
- The engine coolant temperature (ECT) is between -7 and +130°C (+19 and +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 (TCS) 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.
- DTC P0300 runs continuously once the above conditions are met.

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

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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:
  – Thickness variation of the brake rotors.
  – The drive shaft not balanced.
  – Worn or damaged accessory drive belt--Refer to Symptoms - 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 Powertrain Schematics.

Test Description

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

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

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *You must perform the Crankshaft Position (CKP) System Variation Learn Procedure before proceeding with this diagnostic table. Refer to Crankshaft Position System Variation Learn.* 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 Misfire current counters incrementing?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	Can any abnormal engine noise be heard?	—	Go to Symptoms - Engine Mechanical	Go to Step 5
5	Does the scan tool indicate that the heated oxygen sensor (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

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Inspect the following components: • The vacuum hoses and seals for splits, restrictions, and improper connections. • The throttle body and intake manifold for vacuum leaks • The crankcase ventilation system for vacuum leaks--Refer to Crankcase Ventilation System Inspection/Diagnosis. • The powertrain control module (PCM) grounds for corrosion and loose connections. • The exhaust system for restrictions--Refer to Restricted Exhaust. • The fuel for contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
8	**IMPORTANT:** *An erratic or inconsistent spark is considered a no spark.* 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. 4. Start the engine. Does the spark jump the tester gap?	—	Go to Step 10	Go to Step 9
9	1. Remove the spark plug wire for the affected cylinders. 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 resistance within the specified value?	397-1,337 ohms	Go to Electronic Ignition (EI) System Diagnosis	Go to Step 19

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Remove the spark plug from the cylinder that indicated a misfire. Refer to Spark Plug Replacement. 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	Is the spark plug oil or coolant fouled?	—	Go to Symptoms - Engine Mechanical	Go to Step 13
13	Is the spark plug gas fouled?	—	Go to Step 16	Go to Step 14
14	Did the spark plug 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 Solenoid Coil Test. Did you find and correct the condition?	—	Go to Step 20	Go to Symptoms - Engine Mechanical
16	Perform the fuel system diagnosis. Refer to Fuel System Diagnosis. Did you find and correct the condition?	—	Go to Step 20	Go to Symptoms - Engine Mechanical
17	Replace or gap the spark plug. Refer to Spark Plug Replacement. Did you complete the action?	—	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 wires. Refer to Spark Plug Wire Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	Was the customer concern the malfunction indicator lamp (MIL) flashing?	—	Go to Step 21	Go to Step 22

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
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?	2,500 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 - Vehicle	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 CKP 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 wide 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 CKP system variation values are not stored in the PCM memory, DTC P0315 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0315 Crankshaft Position (CKP) System Variation Not Learned

Conditions for Running the DTC

- DTCs P0335, P0336, P0341, P0342, or P0343 are not set.
- DTC P0315 runs every 100 milliseconds.

Conditions for Setting the DTC

- The CKP system variation values are not stored in the PCM memory.
- The enable counter equals 0.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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

- 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 P315				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *The Crankshaft Position Variation Learn Procedure may have to be repeated up to 5 times before the procedure is learned.* Perform the Crankshaft Position (CKP) System Variation Learn Procedure. Refer to Crankshaft Position System Variation Learn. Does the scan tool display Learned this ignition?	—	Go to Step 4	Go to Step 3
3	If the CKP system variation learn procedure cannot be performed successfully, check for the following conditions and correct as necessary: • Worn crankshaft main bearings • A damaged reluctor wheel • Excessive crankshaft runout • A damaged crankshaft • Interference in the signal circuit of the CKP sensor • Any foreign material passing between the CKP sensor and the reluctor wheel • A coolant temperature that is not within the Conditions For Running the DTC • The ignition switch is in the ON position until the battery is drained. • 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	—

DTC P315				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 as specified in the supporting text. 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 - Vehicle	System OK

DTC P0325

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. When the engine is running, the powertrain control module (PCM) learns a minimum and maximum frequency of normal engine noise. The KS system monitors both knock sensors in order to determine if knock is present. If the KS system determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS. The PCM continues to retard timing until no knock is present. If the PCM malfunctions in a manner that will not allow proper diagnosis of the KS system, DTC P0325 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0325 Knock Sensor (KS) Circuit

Conditions for Running the DTC

- The engine run time is more than 10 seconds.
- The ignition voltage is more than 10 volts.
- DTC P0325 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM malfunctions in a manner that will not allow proper diagnosis of the KS system for more than 15 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 4	—
4	1. Start the engine. 2. Operate the vehicle within the conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. 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 - Vehicle	System OK

DTC P0327 or P0332

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. When the engine is running, the powertrain control module (PCM) learns a minimum and maximum frequency of normal engine noise. The KS system monitors both knock sensors in order to determine if knock is present. If the KS system determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS. The PCM continues to retard timing until no knock is present. If the PCM detects that the frequency is out of the normal range, DTC P0327 or P0332 will set.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0327 Knock Sensor (KS) 1 Circuit Low Frequency
- DTC P0332 Knock Sensor (KS) 2 Circuit Low Frequency

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0220, or P2135 are not set.
- The minimum noise level must be learned. The minimum noise level is learned when the following conditions are met:
  - The engine coolant temperature (ECT) is more than 60°C (140°F).
  - The engine RPM is between 475-975 for 10 seconds.
- The engine speed is between 1,500-3,000 RPM.
- The manifold absolute pressure (MAP) is less than 45 kPa.
- The engine run time is more than 10 seconds.
- The ignition voltage is more than 10 volts.
- DTC P0327 or DTC P0332 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected KS signal is less than the expected amount for more than 9 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 KS is dropped, the sensor must be replaced.

- Inspect the KS 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 Testing for Intermittent Conditions and Poor Connections.

DTC P0327 or P0332				
Step	Action	Value(s)	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 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. 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. Turn OFF the ignition. 2. Remove the intake manifold sight shield. 3. Disconnect the knock sensor (KS) inline harness connector. 4. Measure the resistance from the signal circuit of the affected KS to a good ground with a DMM. Is the resistance of the KS within the specified range?	93K-107K ohms	Go to Step 4	Go to Step 6

DTC P0327 or P0332				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	**IMPORTANT:** *Do not tap on any plastic engine components.* 1. Set the DMM to the 400 mV AC hertz scale. 2. Measure the AC voltage from the signal circuit of the affected KS to a good ground with a DMM. 3. Tap on the engine block near the affected KS while observing the DMM. Does the voltage change on the DMM while tapping on the engine block near the KS?	—	Go to Step 5	Go to Step 10
5	Test the affected KS signal circuit between the powertrain control module (PCM) and the KS inline harness connector for the following conditions: • An open or a high resistance • A short to voltage • A short to ground Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
6	1. Remove the intake manifold. Refer to Intake Manifold Replacement. 2. Test the affected signal circuit between the KS inline harness connector and the affected KS connector for an open, high resistance or short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test for an intermittent and for a poor connection at the affected KS. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P0327 or P0332				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Test for an intermittent and for a poor connection at the KS inline harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
9	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the affected knock sensor. Refer to Knock Sensor (KS) Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. You may also operate the vehicle within 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 - Vehicle	System OK

DTC P0335

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor circuits are 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 there is no signal from the CKP sensor for 8 seconds, DTC P0335 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0335 Crankshaft Position (CKP) Sensor Circuit

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0341, P0342, or P0343 are not set.
- The camshaft position (CMP) sensor signal is incrementing.
- The mass air flow (MAF) is more than 3 g/s.
- The ignition switch is in the Crank position.
- DTC P0335 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects there is no signal from the CKP sensor for 8 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 determines if the fault is present.
6. This step simulates a CKP sensor signal to the PCM. If the PCM receives the signal, the fuel pump will operate for about 2 seconds.

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Attempt to start the engine. Does the engine start and continue to run?	—	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 Testing for Intermittent Conditions and Poor Connections
4	1. Raise the vehicle. 2. Remove the starter. 3. Disconnect the crankshaft position (CKP) sensor connector. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the 12-volt reference circuit of the CKP sensor to a good ground with a DMM. Is the voltage within the specified value?	B+	Go to Step 5	Go to Step 7
5	Measure the voltage between the 12-volt reference circuit of the CKP sensor and the low reference circuit of the CKP sensor with a DMM. Is the voltage within the specified value?	B+	Go to Step 6	Go to Step 8

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Momentarily connect a test lamp between the CKP sensor signal circuit and the 12-volt reference of the CKP sensor. Does the fuel pump operate when the test lamp is applied to the CKP sensor signal circuit?	—	Go to Step 10	Go to Step 9
7	Test the 12-volt reference circuit for the following conditions: • An open • A short to ground • High resistance Refer to Circuit Testing and Wiring Repairs. Did you find and correct condition?	—	Go to Step 16	Go to Step 12
8	Test the low reference circuit for the following conditions: • An open • A short to voltage • High Resistance Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12
9	Test the CKP sensor signal circuit for the following conditions: • An open • A short to ground • A short to voltage • High resistance Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Remove the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. 2. Visually inspect the CKP sensor for the following conditions: – Physical damage – Loose or improper installation – Wiring routed too closely to the secondary ignition components 3. The following conditions may cause this DTC to set: – Excessive air gap between the CKP sensor and the reluctor wheel – The CKP sensor coming in contact with the reluctor wheel – Foreign material passing between the CKP sensor and the reluctor wheel – Insufficient fuel Did you find and correct the condition?	—	Go to Step 16	Go to Step 11
11	Visually inspect the CKP sensor reluctor wheel for the following conditions: • Loose or improper installation • Physical damage • Excessive end play or looseness Refer to Crankshaft and Bearings Cleaning and Inspection. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
12	Test for poor connections at the CKP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
13	Test for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. Did 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 - Vehicle	System OK

DTC P0336

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor circuits are 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 signal is inconsistent, DTC P0336 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0336 Crankshaft Position (CKP) Sensor Performance

Conditions for Running the DTC

- The engine is cranking or running.
- DTC P0336 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the CKP sensor signal is inconsistent for 3 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTC P0335 is also set, diagnose DTC P0335 before proceeding with this DTC.* 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 Testing for Intermittent Conditions and Poor Connections
3	Inspect all of the crankshaft position sensor (CKP) circuits for the following conditions: • Wiring routed too closely to secondary ignition wires or components • Wiring routed too closely to after-market add-on electrical equipment • Wiring routed to closely to solenoids, relays, and motors • Electromagnetic interference in the CKP sensor circuits Did you find and correct the condition?	—	Go to Step 14	Go to Step 4

DTC P0336				
Step	Action	Value(s)	Yes	No
4	1. Raise the vehicle. 2. Remove the starter. 3. Disconnect the CKP sensor connector. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the 12-volt reference circuit of the CKP sensor with a DMM. Is the voltage within the specified value?	B+	Go to Step 5	Go to Step 13
5	Test the 12-volt reference circuit for an intermittent condition or shorted to other circuits. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. Did you find and correct the condition?	—	Go to Step 14	Go to Step 6
6	Test the low reference circuit for an intermittent condition. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	Test the CKP sensor signal circuit for an intermittent condition. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. 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 CKP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	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 Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Remove the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. 2. Inspect the CKP sensor for the following conditions: – Physical damage – Loose or improper installation – Excessive play or looseness – Excessive air gap between the CKP sensor and the reluctor wheel – Foreign material passing between the CKP sensor and the reluctor wheel – Insufficient fuel Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Inspect the reluctor wheel for the following conditions: • Physical damage • Loose or improper installation • Excessive end play or looseness Refer to Crankshaft and Bearings Cleaning and Inspection. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
12	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 15	Go to Step 2
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 - Vehicle	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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0341 Camshaft Position (CMP) Sensor Performance

Conditions for Running the DTC

- The engine is running and the engine speed is less than 4,000 RPM.
- DTC P0341 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that a CMP to CKP mis-match has occurred for more than 10 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 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: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connection
3	1. Visually and physically inspect all circuits going to the camshaft position (CMP) sensor for the following: – 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. 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 powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	Go to Step 9	Go to Step 6

DTC P0341			
Step	**Action**	**Yes**	**No**
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 – The sensor coming in contact with the reluctor ring – Foreign material passing between the sensor and the reluctor ring – Wiring routed too close to secondary ignition components Did you find and correct the condition?	Go to Step 9	Go to Step 7
7	Visually inspect the CMP sensor reluctor ring for the following conditions: • Physical damage • Excessive end play or looseness • Loose or improper installation Refer to Camshaft and Bearings Cleaning and Inspection. 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. 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

DTC P0341			
Step	**Action**	**Yes**	**No**
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 - Vehicle	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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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 signal is constantly low, DTC P0342 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0342 Camshaft Position (CMP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.
- DTC P0342 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is low for more than 5 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP sensor high to low and low to high parameter to increase if the circuit and the PCM are operating properly.

DTC P0342			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. 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. Does the test lamp illuminate?	Go to Step 5	Go to Step 6

DTC P0342			
Step	Action	Yes	No
5	1. Start the engine. 2. Observe the CMP sensor high to low and low to high transition parameters with the scan tool. 3. Momentarily and repeatedly probe the signal circuit of the CMP sensor with a test lamp that is connected to battery voltage. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	Go to Step 8	Go to Step 7
6	Test the 12-volt reference circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 14
7	Test the CMP sensor signal circuit for an open or a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 9
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. 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 powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 13

DTC P0342			
Step	**Action**	**Yes**	**No**
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 – Wiring routed too close to the secondary ignition components – The sensor coming in contact with the reluctor ring – Foreign material passing between the sensor and the reluctor ring Did you find and correct the condition?	Go to Step 14	Go to Step 11
11	Visually inspect the CMP sensor reluctor ring for the following conditions: • Physical damage • Loose or improper installation • Excessive end play or looseness Refer to Camshaft and Bearings Cleaning and Inspection. 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 Control Module References for replacement, setup, and programming. Did you complete the replacement?	Go to Step 14	—

DTC P0342			
Step	**Action**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0343

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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0343 Camshaft Position (CMP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.
- DTC P0343 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is high for more than 5 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP sensor high to low and low to high parameter to increase if the circuit and the PCM are operating properly.

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. Probe the signal circuit of the CMP sensor with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5

DTC P0343				
Step	Action	Value(s)	Yes	No
5	1. Start the engine. 2. Observe the CMP sensor high to low and low to high transition parameters with the scan tool. 3. Momentarily and repeatedly probe the signal circuit of the CMP sensor with a test lamp that is connected to battery voltage. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	—	Go to Step 6	Go to Step 10
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. 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. 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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
8	Test the low reference circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. 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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 15

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	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. 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 – Wiring routed too close to the secondary ignition components – The sensor coming in contact with the reluctor ring – Foreign material passing between the sensor and the reluctor ring Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
12	Visually inspect the CMP sensor reluctor ring for the following conditions: • Physical damage • Loose or improper installation • Excessive end play or looseness Refer to Camshaft and Bearings Cleaning and Inspection. 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 Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 15	—

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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 spark event for each cylinder through 8 individual ignition control (IC) circuits. When the PCM commands the IC circuit ON, electrical current will flow through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the PCM will command the IC circuit OFF, interrupting current flow through the primary winding. The magnetic field created by the primary winding will collapse across the secondary coil winding, producing a high voltage across the spark plug electrodes. The PCM uses information from the crankshaft position (CKP) and the camshaft position (CMP) sensor for sequencing and timing of the spark events. Each ignition coil/module has the following circuits:

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

If the PCM detects that the IC circuit has an incorrect voltage level, DTC P0351-P0358 will set.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0351 Ignition Coil 1 Control Circuit
- DTC P0352 Ignition Coil 2 Control Circuit
- DTC P0353 Ignition Coil 3 Control Circuit
- DTC P0354 Ignition Coil 4 Control Circuit
- DTC P0355 Ignition Coil 5 Control Circuit
- DTC P0356 Ignition Coil 6 Control Circuit
- DTC P0357 Ignition Coil 7 Control Circuit
- DTC P0358 Ignition Coil 8 Control Circuit

Conditions for Running the DTC

- The engine is running.
- DTC P0351-P0358 runs continuously once the above condition is met.

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

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Testing for Intermittent Conditions and Poor Connections
3	1. Turn OFF the engine. 2. Disconnect the respective ignition coil. 3. Start the engine. 4. Measure the frequency at the ignition (IC) circuit with the DMM set to DC Hertz. Refer to Measuring Frequency. 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
5	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM) connector. 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

DTC P0351-P0358				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the respective IC circuit for a short to ground. Refer to Testing for Short to Ground. 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. 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. 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. 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. 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. 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. Did you complete the repair?	—	Go to Step 17	—

DTC P0351-P0358				
Step	Action	Value(s)	Yes	No
13	Repair the IC circuit for a short to voltage. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 17	—
14	Repair open in the IC circuit. Refer to Wiring Repairs. 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 Control Module References for replacement, setup, and programming. 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 - Vehicle	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 (CO_2), 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 the PCM uses to indicate the oxygen storage capacity of the catalyst. This determines the catalysts ability to effectively convert the exhaust emissions.

If the catalyst is functioning correctly, the HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 signals will be far less active than the signals that are produced by HO2S bank 1 sensor 1 and 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 conditions occur:

- The air-to-fuel ratio transitions from lean to rich.
- The air-to-fuel ratio transitions from 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 greater than 600 mV, and from greater 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.

IMPORTANT:
A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.

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.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0420 Catalyst System Low Efficiency Bank 1
- DTC P0430 Catalyst System Low Efficiency Bank 2

Conditions for Running the DTC

- DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0171, P0172, P0174, P0175, P0178, P0179, P0200, P0220, P0300, P0335, P0336, P0341, P0342, P0343, P0351-P0358, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0500, P0502, P0503, P0506, P0507, P1125, P1133, P1134, P1153, P1154, P1258, P1516, P2101, P2108, P2120, P2121, P2125, P2135, P2A01, P2A04 are not set.
- The engine has been running for more than 5 minutes.
- The intake air temperature (IAT) is between -20 and +85°C (-4 and +185°F).
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine coolant temperature (ECT) is more than 70-125°C (158-257°F).
- Since the end of the last idle period, the engine speed has been greater than 1,000 RPM for 26 seconds.
- The engine must be at a stable idle speed, within 200 RPM of desired idle.
- The battery voltage is greater than 11 volts.
- The Closed Loop fuel control is enabled.
- This diagnostic attempts up to one test during each valid idle period when the above conditions have been met for 3.5 seconds. This diagnostic attempts up to 12 tests during each drive cycle.

Conditions for Setting the DTC

- The PCM determines that the oxygen storage capability of the TWC has degraded to less than a calibrated threshold.
- This diagnostic may conclude in only one test attempt. However this diagnostic may require as many as 18 test attempts, which would require 3 ignition cycles. Each test attempt occurs within 15 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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

- The catalyst test may abort due to a change in the engine load. Do not change the engine load, ensure the AC is OFF, the coolant fan is not cycling, while a catalyst test is in progress.
- Driving the vehicle under the conditions outlined in the Inspection/Maintenance (I/M) section can verify whether the fault is present.
- 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 Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. 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 steps inspects for conditions than can cause the TWC efficiency to appear degraded.

DTC P0420 or P0430 (without HP2)				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Review the DTC information on the scan tool. Are any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	**IMPORTANT:** *A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.* 1. Start and idle the engine. 2. Allow the engine to reach operating temperature. 3. Increase the engine speed to 2,000 RPM for 2 minutes. 4. Ensure Closed Loop operation is enabled. 5. Return the engine to a stabilized idle. 6. Observe the HO2S 2 voltage parameter on the scan tool for the applicable bank. Is the applicable 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 P0430 set?	—	Go to Step 5	Go to Diagnostic Aids

DTC P0420 or P0430 (without HP2)				
Step	Action	Value(s)	Yes	No
5	**IMPORTANT:** *Verify that the three-way catalytic converter (TWC) is a high quality part that meets the OEM specifications.* Visually and physically inspect the TWC for the following conditions: • Physical damage • Severe discoloration caused by excessive temperatures • Internal rattles caused by loose catalyst substrate • Restrictions--Refer to Restricted Exhaust. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	Visually inspect the exhaust system for the following conditions: • Leaks • 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	—

DTC P0420 or P0430 (without HP2)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	**NOTICE:** *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 TWC. 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. **CAUTION:** ***Refer to Road Test Caution in Cautions and Notices.*** **IMPORTANT:** *A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.* 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 Step11
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 - Vehicle	System OK

DTC P0442

Diagnostic Instructions

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

DTC Descriptor

DTC P0442 : Evaporative Emission (EVAP) System Small Leak Detected

Circuit Description

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

Conditions for Running the DTC

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

- The BARO is more than 74 kPa.
- The engine run time before engine shut-off was greater than 10 minutes.
- The drive distance before engine shut-off was more than 5 kilometers (3.1 miles).
- The ignition is OFF.
- The ambient air temperature at the end of the drive cycle is between 0-32°C (32-93°F).
- DTC P0442 runs once per drive cycle during the hot soak period after the ignition is turned OFF and may require up to 45 minutes to complete. The controller will not make more than 2 test attempts per day. The time since the last completed EONV test must be at least 17 hours.

Conditions for Setting the DTC

- The control module detects a leak in the EVAP system that is greater than a calibrated amount.
- Several EONV tests must complete before the diagnostic can report the results.

Action Taken When the DTC Sets

DTC P0442 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0442 is a Type A DTC.

Diagnostic Aids

- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the J 41413-SPT.
- To help locate intermittent leaks using the J 41413-200 , move all EVAP components while observing smoke with the J 41413-SPT.
- Individual components can be isolated and tested using J 41413-300.
- 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.

Reference Information

Schematic Reference

Evaporative Emissions Hose Routing Diagram

DTC Type Reference

Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Special Tools Required

- J 41413-SPT High Intensity White Light
- J 41413-200 Evaporative Emissions System Tester (EEST)
- J 41413-300 EVAP Cap and Plug Kit
- J 41413-311 EVAP Plug

Circuit/System Testing

IMPORTANT:

- Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.
- Refer to the J 41413-200 operation manual for detailed instructions.

1. Connect the J 41413-200 to the vehicle at the EVAP service port.
2. Seal the EVAP system and use the flow meter on the J 41413-200 , calibrated to 0.51 millimeter (0.020 inch) to determine that there is no leak in the EVAP system.
   - If a leak is detected, use the J 41413-200 to apply smoke to the EVAP system's service port until the leak is located.

Repair Instructions

The malfunction indicator lamp (MIL) may remain ON after the repair unless the DTCs are cleared.

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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0443 Evaporative Emission (EVAP) Purge Solenoid Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 10-18 volts.
- DTC P0443 runs continuously once the above conditions are met.

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

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 PWM. You should hear a clicking sound when the EVAP canister purge solenoid valve is commanded to 50 percent. The clicking sound should stop when the EVAP canister purge solenoid valve is commanded to 0 percent. The rate at which the valve cycles should increase when the commanded state is increased, and decrease when the commanded state is decreased.
5. This step verifies that the control module is providing ground to the EVAP canister purge solenoid valve.
6. This step tests if a ground is constantly being applied to the EVAP canister purge solenoid valve.

DTC P0443			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister purge solenoid valve to 50 percent, then to 0 percent with a scan tool. Does the EVAP canister purge solenoid valve respond to the commanded state?	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 Testing for Intermittent Conditions and Poor Connections
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

DTC P0443			
Step	**Action**	**Yes**	**No**
5	1. Connect a test lamp between the control circuit of the EVAP canister purge solenoid valve and the 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 illuminate?	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 for a short to voltage. Refer to Circuit Testing and Wiring Repairs. 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. Did you find and correct the condition?	Go to Step 14	Go to Step 13
9	Inspect for poor connections at the harness connector of the EVAP canister purge solenoid valve. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 13

DTC P0443			
Step	**Action**	**Yes**	**No**
11	Repair the open or short to ground in the ignition 1 voltage circuit. Refer to Wiring Repairs. 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 powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	Go to Step 14	—
14	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 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 - Vehicle	System OK

DTC P0446

System Description

This DTC tests the Evaporative Emission (EVAP) System for a restricted or blocked EVAP 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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0446 Evaporative Emission (EVAP) Vent System Performance

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0451, P0452, P0453, P0454, P0455, P0464, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is greater 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.
- DTC P0446 runs once per cold start when the above conditions are met.

Conditions for Setting the DTC

- The fuel tank pressure sensor is less than -12 inches H2O.
- The above condition is present for more than 5 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 using the Evaporative Emission System Tester (EEST) to apply pressure, you can regulate the amount of pressure by activating the remote switch ON and OFF while observing pressure in the EVAP system using a scan tool. DO NOT use more than 5 inches H2O. More than 5 inches H2O applied to the EVAP system can cause the canister vent solenoid valve to temporarily remain in the closed position, which could lead to misdiagnosis in this procedure.
- 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 Testing for Intermittent Conditions and Poor Connections.
- An EVAP canister, vent hose, or vent solenoid valve that has restricted flow may cause this DTC to set. Using a purge solenoid valve command with a scan tool will allow vacuum to be applied to the system instead of pressure. With the EVAP canister vent solenoid valve open and the EVAP canister purge solenoid valve commanded to 100 percent, vacuum should not increase to more than 9 inches H2O.

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Inspect the Evaporative Emission (EVAP) System for the following conditions: • A damaged EVAP canister vent solenoid valve. • A pinched EVAP 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. Remove the fuel filler cap. 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

DTC P0446				
Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect the J 41413-200 Evaporative Emission 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 Fuel Tank Cap Adapter to the fuel fill pipe. 4. Connect the fuel fill cap to the J 41415-40 or to GE-41415-50. 5. Connect the J 41413-200 nitrogen/smoke supply hose to J 41415-40 or to GE-41415-50. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP canister vent solenoid valve closed with a scan tool. 8. Turn the nitrogen/smoke valve on the J 41413-200 control panel to NITROGEN. **IMPORTANT:** *DO NOT exceed the specified value in this step. Exceeding the specified value may cause the EVAP canister vent solenoid valve to remain closed, or produce incorrect test results.* 9. Use the remote switch to pressurize the EVAP system to the first specified value. 10. Observe the fuel tank pressure sensor in H2O with a scan tool. 11. 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 5	Go to Step 7

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Connect the J 41413-200 nitrogen/smoke supply hose and the vehicle fuel fill cap to the J 41415-40 or GE-41415-50. 2. Start the engine. 3. Allow the engine to idle. 4. Use the purge/seal function to seal the system with a scan tool. 5. Command the EVAP canister purge solenoid valve to 20 percent. 6. Observe the vacuum/pressure gage of the J 41413-200 and the FTP parameter on the scan tool. 7. Allow the vacuum to increase on the gage of the J 41413-200 until it reaches approximately 16 inches H2O. Did the pressure reading on the J 41413-200 gage agree with the scan tool FTP parameter until the vacuum reached the abort limit on the scan tool?	—	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 12
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 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 for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
10	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Repair the pinched or restricted EVAP 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. 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. Remove the fuel filler cap. 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

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	**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 J 41413-200 to the fuel fill pipe. 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. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0449

Circuit Description

A battery positive 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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0449 Evaporative Emission (EVAP) vent Solenoid Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 10-18 volts.
- DTC P0449 runs continuously once the above conditions are met.

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

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. Listen for a click when the valve operates. Verify that both the ON and the OFF states are commanded.

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: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister vent solenoid valve ON and OFF with the scan tool. Do you hear or feel a click from the EVAP canister vent solenoid valve when the valve 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 Testing for Intermittent Conditions and Poor Connections
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 batter positive voltage circuit of the EVAP canister vent solenoid valve with a test lamp connected to a good ground. Refer to Troubleshooting with a Test Lamp. Does the test lamp illuminate?	Go to Step 5	Go to Step 11

DTC P0449			
Step	**Action**	**Yes**	**No**
5	1. Connect a test lamp between the control circuit of the EVAP canister vent solenoid valve and battery positive voltage circuit of the EVAP canister vent solenoid valve at the EVAP canister vent solenoid valve harness connector. 2. Command the EVAP canister vent solenoid valve ON and OFF with a scan tool. Does the test lamp turn ON and 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 of the EVAP canister vent solenoid valve for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 10
8	Test the control circuit of the EVAP canister vent solenoid valve for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 10
9	Inspect for poor connections at the harness connector of the EVAP canister vent solenoid valve. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 13

DTC P0449			
Step	**Action**	**Yes**	**No**
11	**IMPORTANT:** *If the fuse is open, inspect all related circuits for a short to ground.* Repair the open or short to ground in the battery positive voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	Go to Step 14	—
12	Replace the EVAP canister vent solenoid valve. Did you complete the replacement?	Go to Step 14	—
13	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	Go to Step 14	—
14	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 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 - Vehicle	System OK

DTC P0451

System Description

The fuel tank pressure (FTP) sensor measures air pressure or vacuum in the evaporative emission (EVAP) system. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal voltage varies, depending on EVAP system pressure or vacuum. The controller uses this FTP signal to determine atmospheric pressure for use in the engine-off small leak test, P0442. Before using this signal as an atmospheric reference, it must first be re-zeroed. If the FTP signal is out of range during the re-zero procedure, this DTC will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0451 Fuel Tank Pressure (FTP) Sensor Performance

Conditions for Running the DTC

- DTC P0451 runs only when the engine-off natural vacuum small leak test, DTC P0442, executes.
- The number of times this test runs can range from 0-2 per engine-off period. The length of the test can be up to 40 minutes.

Conditions for Setting the DTC

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

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 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 DTC with a scan tool.

Diagnostic Aids

- A restriction in the EVAP canister or vent lines could prevent fuel vapor pressure from bleeding off fast enough. If the vent system cannot bleed off pressure fast enough, this code can set. When pressure is applied to the system and released, a properly operating system will return to the atmospheric pressure rapidly. By using a scan tool and the J 41413-200 Evaporative Emission System Tester (EEST), pressure can be applied to the system, then released, while monitoring the FTP sensor parameter to see that pressure can be released within 30 seconds.
- An FTP sensor that is skewed or does not have a linear transition from low to high may cause this code to set. Scan tool output controls, snapshot, and plot functions can help detect erratic sensor response. To test the sensor signal under vacuum conditions, use the Quick Snapshot and the Purge/Seal functions to capture data while commanding purge to 20 percent, then plot the data to look for erratic sensor operation. A similar test can be done for the pressure side of the sensor operation by applying pressure with the J 41413-200 while taking a snapshot.
- A full fuel tank may cause misdiagnosis.
- When using the electronic emission system tester (EEST) to apply pressure, you can regulate the amount of pressure by activating the remote switch ON and OFF while observing pressure in the EVAP system using a scan tool.

Test Description

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

4. This step tests for the signal voltage that represents atmospheric pressure. Removing the fuel fill cap ensures a vented EVAP system. Record the value for possible use later in the diagnostic table.
5. This step tests the accuracy of the FTP sensor by comparing the electrical signal value to the EEST mechanical gage value.
8. A restricted EVAP system will not allow the nitrogen to flow freely through the system. A restriction will cause the FTP signal voltage parameter to decrease as the pressure builds.

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram and 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 - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC P0446, P0452, P0453, or P0651 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Inspect the evaporative emission (EVAP) system for the following conditions: • A damaged EVAP canister vent solenoid valve. • A pinched EVAP hose • A damaged EVAP canister--Refer to Evaporative Emission (EVAP) Canister Replacement. Did you find and correct the condition?	—	Go to Step 17	Go to Step 4
4	1. Remove the fuel fill cap. 2. Turn ON the ignition, with the engine OFF. 3. Observe and record the fuel tank pressure (FTP) parameter in volts with a scan tool. Is the fuel tank pressure sensor parameter within the specified amount?	1.3-1.7 V	Go to Step 5	Go to Step 14

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *Ensure that the vehicle underbody temperature is similar to the ambient temperature.* 1. Turn OFF the ignition. 2. Install the fuel fill cap. 3. Connect J 41413-200 Evaporative Emission System Tester (EEST) power supply clips to a known good 12-volt source. 4. Install J 41415-40 Fuel Tank Cap Adapter or the GE-41415-50 Fuel Cap Adapter to the fuel fill pipe. 5. Connect J 41413-200 NITROGEN/SMOKE supply hose to the J 41415-40 or the GE-41415-50 to the fuel fill pipe. 6. Turn ON the ignition, with the engine OFF. 7. Turn the NITROGEN/SMOKE valve on J 41413-200 to NITROGEN. 8. Using a scan tool PURGE/SEAL function, seal the EVAP system. 9. Observe the fuel tank pressure sensor in H2O using a scan tool. 10. Use a remote switch to pressurize the EVAP system to the first specified value. 11. Allow at least 30 seconds for pressure in the EVAP system to stabilize. Compare the fuel tank pressure (FTP) parameter in H2O to J 41413-200 VACUUM/PRESSURE gage. Is the difference between the FTP parameter on a scan tool and the VACUUM/PRESSURE gage on J 41413-200 within the second specified value?	5 in H2O 1 in H2O	Go to Step 6	Go to Step 14
6	Release the pressure on the EVAP system with the scan tool. Is the difference between the FTP parameter on the scan tool and the VACUUM/PRESSURE gage on J 41413-200 within the specified value?	1 in H2O	Go to Step 7	Go to Step 14

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Start the engine. 2. Allow the engine to idle. **IMPORTANT:** *Using more than 20 percent purge can cause a misdiagnosis.* 3. Use the PURGE/SEAL function of a scan tool to command 20 percent purge. 4. Observe the VACUUM/PRESSURE gage on J 41413-200 and the fuel tank pressure parameter on the scan tool. Allow the vacuum to increase to the first specified value. Is the difference between the FTP parameter on the scan tool and the VACUUM/PRESSURE gage on J 41413-200 within the second specified value?	5 in H2O 1 in H2O	Go to Step 8	Go to Step 14
8	1. Turn ON the ignition, with the engine OFF. 2. Turn the NITROGEN/SMOKE valve on J 41413-200 to NITROGEN. 3. Observe the FTP sensor in volts using a scan tool. 4. Pressurize the EVAP system with the remote switch. 5. Allow enough time for pressure to stabilize. Is the difference between the observed FTP sensor voltage and the voltage recorded in step 4 greater than the specified value?	0.2 V	Go to Step 9	System OK

DTC P0451				
Step	Action	Value(s)	Yes	No
9	1. Disconnect the EVAP vent hose from the EVAP canister vent solenoid valve with pressure still applied from J 41413-200. 2. Observe the FTP sensor in volts using a scan tool. Is the difference between the observed FTP sensor voltage and the voltage recorded in step 4 greater than the specified value?	0.2 V	Go to Step 10	Go to Step 11
10	1. Disconnect the EVAP vapor pipe from the EVAP canister with pressure still applied from J 41413-200. 2. Observe the FTP sensor in volts using a scan tool. Is the difference between the observed FTP sensor voltage and the voltage recorded in step 4 greater than the specified value?	0.2 V	Go to Step 13	Go to Step 12
11	Repair or replace the EVAP canister vent solenoid. Did you complete the action?	—	Go to Step 17	—
12	Replace the EVAP canister. Refer to Evaporative Emission (EVAP) Canister Replacement. Did you complete the replacement?	—	Go to Step 17	—
13	Repair or replace the pinched or restricted EVAP vapor pipe. Did you complete the action?	—	Go to Step 17	—
14	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. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
16	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all components and release any pressure or vacuum applied to the EVAP system. 2. Turn ON the ignition, with the engine OFF. 3. Observe and record the fuel tank pressure (FTP) parameter in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified amount?	-1 to +1 in H2O	Go to Step 18	Go to Step 2
18	1. Turn ON the ignition, with the engine OFF. 2. Command the EVAP canister vent solenoid closed with a scan tool. 3. Turn the NITROGEN/SMOKE valve on J 41413-200 to NITROGEN. 4. Pressurize the EVAP system to the first specified value with the remote switch. 5. Observe the fuel pressure sensor in H2O using a scan tool. 6. 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 19	Go to Diagnostic Aids
19	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 20

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	**IMPORTANT:** *The malfunction indicator lamp (MIL) may remain ON after the repair unless the DTCs are cleared.* Clear the DTCs with a scan tool. Did you complete the action?	—	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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0452 Fuel Tank Pressure (FTP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0452 runs continuously once the above condition is met.

Conditions for Setting the DTC

- The FTP sensor voltage is less than 0.1 volts.
- All conditions are present for more than 5 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. This step 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: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with a scan tool. Did DTC P0641 or P0651 fail this ignition?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Observe the fuel tank pressure sensor parameter with the scan tool. Does the scan tool indicate that fuel tank pressure sensor parameter is 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 Testing for Intermittent Conditions and Poor Connections

DTC P0452				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Raise and support the vehicle. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the fuel tank pressure (FTP) sensor and the signal circuit of the FTP sensor. 5. Turn ON the ignition, with the engine OFF. 6. Observe the fuel tank pressure sensor voltage with a scan tool. Is the fuel tank pressure sensor parameter greater than the specified value?	4.8 V	Go to Step 8	Go to Step 6
6	Test the 5-volt reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test the signal circuit of the FTP sensor for a short to ground, or an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Remove the fuel tank. 2. Inspect the fuel tank wiring harness for the following: – Damaged wiring – Poor connections – Broken wires inside the insulation--Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P0452				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. 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 powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—
12	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 2	Go to Step 13
13	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0453 Fuel Tank Pressure (FTP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0453 runs continuously once the above condition is met.

Conditions for Setting the DTC

- The FTP sensor voltage is more than 4.9 volts.
- All conditions are present for more than 5 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 P0641 or P0651 is set, the 5-volt reference circuit may be shorted to a voltage.

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Did DTC P0641 or P0651 fail this ignition?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the fuel tank pressure sensor voltage 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 Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Raise and support the vehicle. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Observe the fuel tank pressure (FTP) sensor voltage with a scan tool. Does the scan tool indicate that the fuel tank pressure sensor parameter is more than the specified value?	1 V	Go to Step 6	Go to Step 7

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the signal circuit of the FTP for a short to voltage between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	Probe the low reference circuit of the FTP sensor at the fuel tank harness connector with a test lamp connected to battery voltage. Refer to Circuit Testing. Did the test lamp illuminate?	—	Go to Step 9	Go to Step 8
8	Test the low reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Remove the fuel tank. 2. Disconnect the FTP sensor harness connector. 3. Inspect the fuel tank wiring harness for the following conditions: • Damaged wiring • Poor connections • Broken wires inside the insulation--Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. 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	—

DTC P0453				
Step	Action	Value(s)	Yes	No
12	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 13	—
13	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 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 - Vehicle	System OK

DTC P0454

System Description

The fuel tank pressure (FTP) sensor measures air pressure or vacuum in the evaporative emission (EVAP) system. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal voltage varies depending on EVAP system pressure or vacuum. The controller uses this FTP signal to determine atmospheric pressure for use in the engine OFF small leak test, P0442. This DTC will set if the control module detects an intermittent signal from the FTP that would prevent the engine-off small leak test, P0442, from running.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0454 Fuel Tank Pressure (FTP) Sensor Circuit Intermittent

Conditions for Running the DTC

- DTC P0454 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- This test can run once per engine-off period. The length of the test can be up to 40 minutes.

Conditions for Setting the DTC

If, during the engine-off natural vacuum small leak test, P0442, the powertrain control module (PCM) detects an abrupt FTP signal change, other than a refueling event, this DTC will set.

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 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 DTC with a scan tool.

Diagnostic Aids

Scan tool output controls, snapshot, and plot functions can help detect erratic sensor response. To look at the sensor signal under vacuum conditions, use snapshot and the purge/seal function to capture data while commanding purge to 20 percent, then plot the data to look for non-linear sensor operation. A similar inspection can be done for the pressure side of the sensor range by applying pressure with J 41413-200 Evaporative Emission System Tester (EEST) while taking a snapshot. DO NOT exceed 5 inches H2O when applying pressure.

DTC P0454			
Step	**Action**	**Yes**	**No**
Schematic Reference: Evaporative Emissions Hose Routing Diagram and Engine Controls Schematics Connector End View Reference: Powertrain Control Module Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Are DTCs P0442, P0446, P0452, P0453, or P0651 also set?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Inspect for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections. Did you find and correct the condition?	Go to Step 5	Go to Step 4
4	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	Go to Step 5	—
5	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0455

Diagnostic Instructions

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

DTC Descriptor

DTC P0455: Evaporative Emission (EVAP) System Large Leak Detected

Circuit/System Description

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

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

Conditions for Running the DTC

- Before the PCM can report DTC P0455 failed, DTC P0496 must run and pass.
- DTCs P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0442, P0443, P0449, P0451, P0452, P0453, P0454, P0464, P0496, P0608, P0609, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138 are not set.
- The ignition voltage is between 11-18 volts.
- The barometric pressure (BARO) is more than 74 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is less than 35°C (95°F).

- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- DTC P0455 runs once per cold start when the above conditions are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTC P0455 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0455 is a Type B DTC.

Diagnostic Aids

- A fuel fill cap that is left OFF after a fuel fill will cause this DTC to set.
- A loose, missing, or damaged fuel fill cap can cause this DTC to set.
- A blockage or restriction in the EVAP purge solenoid, purge pipe EVAP canister, or vapor pipe, can cause this DTC to set.
- A temporary blockage in the EVAP purge solenoid, purge pipe, or EVAP canister could cause an intermittent condition. Inspect and repair any restriction in the EVAP system.
- To help locate intermittent leaks, use the J 41413-200 to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the J 41413-SPT.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the J 41413-SPT.
- Observe the Freeze Frame/Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition occurs that caused the DTC to set. This may assist in diagnosing the condition.

Reference Information

Schematic Reference

- Evaporative Emissions Hose Routing Diagram
- Engine Controls Schematics

Connector End View Reference

- Powertrain Control Module Connector End Views
- Engine Controls Connector End Views

DTC Type Reference

Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Electrical Information Reference

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

Special Tools Required

- J 41413-SPT High Intensity White Light
- J 41413-200 Evaporative Emissions System Tester (EEST)
- J 41413-300 EVAP Cap and Plug Kit
- J 41413-311 EVAP Plug
- GE-41415-50 Fuel Tank Cap Adapter

Circuit/System Testing

IMPORTANT:

- Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.
- Refer to the J 41413-200 operation manual for detailed instructions.

1. Connect the J 41413-200 to the vehicle service port.
2. Seal the EVAP system and use the flow meter on the J 41413-200 , calibrated to 0.51 mm (0.02 in) to determine that there is no leak in the EVAP system.
   - If a leak is detected, use the J 41413-200 to apply smoke to the EVAP system at the service port until the leak is located.
3. To test for a restriction, connect the J 41413-200 nitrogen/smoke hose to the J 41413-311 brass cone adapter. Disconnect the hose at the fuel cap end of the GE-41415-50. Connect the J 41413-311 to the disconnected hose on the GE-41415-50. Install the GE-41415-50 filler neck end only to the vehicle.
4. Allow the engine to idle.
5. Use the Purge/Seal function to seal the system with a scan tool.
6. Command the EVAP canister purge solenoid valve to 30 percent.
7. The vacuum/pressure gage on the J 41413-200 and the FTP parameter on the scan tool should both show vacuum.
   - If the vacuum/pressure gage shows vacuum, but the FTP parameter does not show vacuum, replace the FTP sensor.
   - If neither the FTP parameter nor the vacuum/pressure gage shows vacuum, repair the restriction in the purge path.
8. Verify that the vacuum increases to the abort limit on the scan tool or more than 3.2 volts, and the value is closely similar between the scan tool and the vacuum/pressure gage on the J 41413-200.
   - If the values are not similar or the voltage did not reach 3.2 volts, replace the FTP sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Fuel Tank Pressure Sensor Replacement
- Evaporative Emission Canister Purge Solenoid Valve Replacement
- Evaporative Emission Canister Vent Solenoid Valve Replacement
- Evaporative Emission Canister Replacement
- Evaporative Emission System Hoses/Pipes Replacement

DTC P0496

System Description

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

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

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0496 Evaporative Emission (EVAP) System Flow During Non-Purge

Conditions for Running the DTC

- DTC P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0452, P0453, P0455, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is greater 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 8°C (14°F) of each other.
- DTC P0496 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- A continuous open purge flow condition is detected during the diagnostic test.
- The fuel tank pressure decreases to less than a calibrated value.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 P0496				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Evaporative Emissions Hose Routing Diagram				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Seal the Evaporative Emission (EVAP) System using the Purge/Seal function with a scan tool. 3. Increase the engine idle to 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified value?	-1 to +1 H2O	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the EVAP purge pipe from the EVAP purge solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 H2O	Go to Step 4	Go to Step 5
4	Replace the EVAP purge solenoid valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
5	Replace the fuel tank pressure (FTP) sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Connect all EVAP hardware that was previously disconnected. 2. Seal the EVAP system using the Purge/Seal function with a scan tool. 3. Start the engine and idle at 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor parameter with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 H2O	Go to Step 7	Go to Step 2

DTC P0496				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0506 (With Throttle Actuator Control)

Circuit Description

The Electronic Throttle Control (ETC) System uses various inputs from the powertrain control module (PCM). This system uses the inputs to control the idle speed through serial data circuits to the throttle actuator control (TAC) module. The DC motor, which is located on the throttle body, activates the throttle plate. In order to decrease idle speed, the TAC module commands the throttle closed, reducing air flow into the engine, and the idle speed decreases. In order to increase the idle speed, the TAC module commands the throttle plate open, allowing more air in order to bypass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, DTC P0506 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0506 Idle Speed Low

Conditions for Running the DTC

- DTCs P0101-P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0125, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0440, P0442, P0443, P0496, P0500, P0502, P0503, P2135 are not set.
- The engine is running for more than 60 seconds.
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The intake air temperature (IAT) is more than -10°C (+14°F).
- The barometric pressure (BARO) is more than 65 kPa.
- The system voltage is between 9-18 volts.
- The vehicle speed is less than 1.7 km/h (1 mph).
- The accelerator pedal position (APP) sensor is at 0 percent.
- DTC P0506 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the actual idle speed is 100 RPM less than the desired idle speed for 5 continuous seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. This test determines if the engine can achieve the commanded RPM.

DTC P0506 (With Throttle Actuator Control)			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views or Powertrain Control Module Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Apply the park brake. 2. Block the drive wheels. 3. Start the engine. 4. Turn OFF all accessories. 5. Command the engine RPM to 1,500 RPM, to 500 RPM, and back to 1,500 RPM with the RPM control function of the scan tool. 6. Exit the RPM Control function. Did the engine speed stay within 100 RPM of the commanded RPM during the above test?	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. Use the following information to operate the vehicle under the conditions which set the DTC: • The data in the Freeze Frame/Failure Records • The parameters listed in the Conditions for Running in the DTC Does the DTC set?	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Inspect for the following conditions: • Deposits in the throttle body • Objects which are blocking the air intake system • Energy-draining load on the engine, such as transmission conditions Did you find and correct the condition?	Go to Step 5	—

DTC P0506 (With Throttle Actuator Control)			
Step	**Action**	**Yes**	**No**
5	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 6
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 - Vehicle	System OK

DTC P0507 (With Throttle Actuator Control)

Circuit Description

The electronic throttle control (ETC) system uses various inputs from the powertrain control module (PCM). This system uses these inputs to control the idle speed through serial data circuits to the throttle actuator control (TAC) module. The DC motor, which is located on the throttle body, activates the throttle plate. In order to decrease idle speed, the TAC module commands the throttle closed, reducing air flow into the engine, and the idle speed decreases. In order to increase the idle speed, the TAC module commands the throttle plate open, allowing more air in order to bypass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, DTC P0507 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0507 Idle Speed High

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0125, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0440, P0442, P0443, P0496, P0500, P0502, P0503, P2135 are not set.
- The engine is running for more than 60 seconds.
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The intake air temperature (IAT) is more than -10°C (+14°F).
- The barometric pressure (BARO) is more than 65 kPa.
- The system voltage is between 9-18 volts.
- The vehicle speed is less than 1.7 km/h (1 mph).
- The accelerator pedal position (APP) sensor is at 0 percent.
- DTC P0507 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the actual idle speed is 200 RPM more than the desired idle speed for 5 continuous seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. This test determines if the engine can achieve the commanded RPM.

DTC P0507 (With Throttle Actuator Control)			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views or Powertrain Control Module Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Apply the park brake. 2. Block the drive wheels. 3. Start the engine. 4. Turn OFF all accessories. 5. Command the engine RPM to 1,500 RPM, to 500 RPM, and back to 1,500 RPM with the RPM control function of the scan tool. 6. Exit the RPM control function. Did the engine speed stay within 200 RPM of the commanded RPM during the above test?	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. Use the following information to operate the vehicle under the conditions which set the DTC: • The data in the Freeze Frame/Failure Records • The parameters listed in the Conditions for Running in the DTC Does the DTC set?	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Inspect for the following conditions: • Vacuum leaks • Deposits in the throttle body • A faulty positive crankcase ventilation (PCV) valve Did you find and correct the condition?	Go to Step 5	—

DTC P0507 (With Throttle Actuator Control)			
Step	**Action**	**Yes**	**No**
5	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 6
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 - Vehicle	System OK

DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610

Description

This diagnostic applies to internal microprocessor integrity conditions within the powertrain control module (PCM). This diagnostic also addresses whether or not the PCM is programmed.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0601 Control Module Read Only Memory (ROM)
- DTC P0602 Control Module Not Programmed
- DTC P0604 Control Module Random Access Memory (RAM)
- DTC P0606 Control Module Internal Performance
- DTC P2610 Control Module Ignition Off Timer Performance

Conditions For Running the DTC

DTC P0601

- The ignition switch is in the Run or Crank position.
- DTC P0601 runs continuously when the above condition is met.

DTC P0602

- The ignition switch is in the ON position.
- DTC P0602 runs continuously when the above condition is met.

DTC P0604

- The ignition switch is in the Run or Crank position.
- DTC P0604 runs continuously when the above condition is met.

DTC P0606

- The ignition switch is in the Run or Crank position, or the key is being turned OFF.
- DTC P0606 runs continuously when the above condition is met.

DTC P2610

- The PCM is powered down.
- DTC P2610 runs once every time the key is turned OFF.

Conditions For Setting The DTC

The PCM detects an internal failure or incomplete programming for more than 5 seconds.

Action Taken When DTC P0601, P0602, P0604, and P0606 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.

Action Taken When DTC P2610 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/DTCs P0601, P0602, P0604, P0606, and P2610

- 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. A DTC P0602 indicates the PCM is not programmed.

DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610			
Step	**Action**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Is DTC P0602 set?	Go to Step 3	Go to Step 5
3	Program the powertrain control module (PCM). Does DTC P0602 reset?	Go to Step 4	Go to Step 6
4	1. Ensure that all tool connections are secure. 2. Ensure that the programming equipment is operating correctly. 3. Ensure that the correct software/calibration package is used. 4. Attempt to program the PCM. Does DTC P0602 reset?	Go to Step 5	Go to Step 6
5	Replace the PCM. Refer to Control Module References in Computer/ Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	—
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	Go to Step 2	Go to Step 7
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	System OK

DTC P0641

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The engine oil pressure (EOP) sensor
- The manifold absolute pressure (MAP) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0641 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0641 5-Volt Reference 1 Circuit

Conditions for Running the DTC

- The engine is running.
- DTC P0641 runs continuously once the above condition is met.

Conditions for Setting the DTC

The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit for more than 2 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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.

9. A short to voltage on the signal circuit of the manifold absolute pressure (MAP) sensor will backfeed through the sensor into the 5-volt reference circuit and set this DTC.

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/Failure Records. Does the DTC fail this ignition?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	1. Turn OFF the ignition. 2. Disconnect the engine oil pressure (EOP) sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the EOP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 4	Go to Step 5
4	1. Connect the EOP sensor. 2. Disconnect the manifold absolute pressure (MAP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 11
5	Is the voltage measured in step 3 more than the specified value?	5.2 V	Go to Step 8	Go to Step 6
6	Monitor the DMM while disconnecting the MAP sensor. Does the voltage return to within the specified range when the MAP sensor is disconnected?	4.8-5.2 V	Go to Step 10	Go to Step 7

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Test all 5-volt reference circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9
9	Test the MAP sensor signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
10	Replace the MAP sensor. Refer to Manifold Absolute Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the EOP sensor. Refer to Engine Oil Pressure Sensor and/or Switch Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 13	—

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0650

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service. The control module monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the control module detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the control module detects an improper voltage on the MIL control circuit, DTC P0650 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0650 Malfunction Indicator Lamp (MIL) Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The ignition voltage is between 6-18 volts.
- DTC P0650 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The control module detects that the commanded state of the MIL driver and the actual state of the control circuit do not match for more than 5 seconds.

Action Taken When the DTC Sets

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

- 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.

6. This step tests for a short to ground in the MIL control circuit. With the powertrain control module (PCM) disconnected and the ignition ON, the MIL should be OFF.
7. This step tests for a short to voltage on the MIL control circuit. With the fuse removed, there should be no voltage on the MIL control circuit.

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics , Power Distribution Schematics , or Engine Controls Schematics Connector End View Reference: Instrument Panel, Gages, and Console Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Command the malfunction indicator lamp (MIL) ON and OFF with a scan tool. Does the MIL 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. Does the DTC fail this ignition?	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Is the MIL always ON?	—	Go to Step 5	Go to Step 5
5	Inspect the fuse that supplies voltage to the MIL. Is the fuse open?	—	Go to Step 15	Go to Step 7
6	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Turn ON the ignition. Is the MIL OFF?	—	Go to Step 12	Go to Step 13

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Remove the fuse that supplies voltage to the MIL. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the MIL control circuit in the PCM harness connector to a good ground. Is the voltage less than the specified value?	0.3 V	Go to Step 8	Go to Step 14
8	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the MIL. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit of the PCM and a good ground. Is the MIL illuminated?	—	Go to Step 12	Go to Step 9
9	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Turn ON the ignition, with the engine OFF. 4. Probe all ignition voltage and battery positive voltage circuits of the IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 16
10	Test the MIL control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct a condition?	—	Go to Step 19	Go to Step 11
11	Test for an intermittent and for a poor connection at the IPC. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 19	Go to Step 7

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
13	Repair the short to ground in the MIL control circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 19	—
14	Repair the short to voltage in the MIL control circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 19	—
15	Repair the short to ground in the voltage supply circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 19	—
16	Repair the open in the ignition voltage or battery positive voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 19	—
17	Replace the IPC. Did you complete the replacement?	—	Go to Step 19	—
18	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 19	—

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	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 20
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0651

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The air conditioning (A/C) pressure sensor
- The fuel tank pressure (FTP) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0651 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0651 5-Volt Reference 2 Circuit

Conditions for Running the DTC

- The engine is running.
- DTC P0651 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit for more than 2 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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.

9. A short to voltage on the signal circuit of the FTP sensor will backfeed through the sensor into the 5-volt reference circuit and set this DTC.

DTC P0651				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/Failure Records. Does the DTC fail this ignition?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	1. Turn OFF the ignition. 2. Disconnect the air conditioning (A/C) pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the A/C pressure sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 4	Go to Step 5
4	1. Connect the A/C pressure sensor. 2. Disconnect the fuel tank pressure (FTP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the FTP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 11
5	Is the voltage measured in step 3 more than the specified value?	1 V	Go to Step 6	Go to Step 7
6	Monitor the DMM while disconnecting the FTP sensor. Does the voltage return to within the specified range when the FTP is disconnected?	4.8-5.2 V	Go to Step 10	Go to Step 7

DTC P0651				
Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Test all 5-volt reference circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9
9	Test the FTP sensor signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
10	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the A/C pressure sensor. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 13	—

DTC P0651				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P1125

Circuit Description

The accelerator pedal position (APP) sensor 1 and the APP sensor 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensors with a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module signal voltages proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 and the APP sensor 2 signal circuits are out of correlation with each other, DTC P1125 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1125 Accelerator Pedal Position (APP) System

Conditions for Running the DTC

- DTC P2108 or U0107 is not set.
- The ignition is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- DTC P1125 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- Both APP sensors are out of range. OR
- Both APP sensors disagree. OR
- One APP sensor is out of range and the other APP sensor disagrees.
- One of the above conditions is present for more than 0.019 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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.

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Record the throttle actuator control (TAC) module calibration with a scan tool. Does the TAC module calibration match the part number of the TAC module?	—	Go to Step 3	Go to Step 11
3	Observe the DTC Information with a scan tool. Is DTC P2120, P2125, or P2138 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the APP Sensors 1 and 2 parameter with a scan tool. Does the scan tool indicate that the APP sensors 1 and 2 parameters disagree?	—	Go to Step 5	Go to Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor. 3. Disconnect the TAC module. 4. Measure the resistance of the following circuits for each of the APP sensors with a DMM: – The low reference circuit – The signal circuit – The 5-volt reference circuit Is the resistance more than the specified value for any circuit?	5 ohms	Go to Step 9	Go to Step 6

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the signal circuit of the APP sensor 1 for a short to the signal circuit of the APP sensor 2. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test for an intermittent and for a poor connection at the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	Test for an intermittent and for a poor connection at the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	Repair the high resistance in the circuit that measured above the specified value. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	—
10	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the TAC module. Refer to Throttle Actuator Control (TAC) Module Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Assemble the vehicle, as necessary. 2. Clear the DTCs with a scan tool. 3. Start the engine. 4. Operate the system in order to verify the repair. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 13

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	**IMPORTANT:** *Be aware that repairing one individual condition may correct more than one DTC.* Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P1133 or P1153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the number of rich to lean and lean to rich transitions. If the PCM detects that the number of transitions were less than a specified value, DTC P1133 sets for HO2S bank 1 sensor 1 or DTC P1153 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1133 HO2S Insufficient Switching Bank 1 Sensor 1
- DTC P1153 HO2S Insufficient Switching Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is greater than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is greater than 1 percent.
- The Fuel Alcohol content parameter is less than 90 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.

- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 1 second.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S lean-to-rich or rich-to-lean transitions are less than a calibrated value for 100 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 the voltage is varying above and below the specified value, the condition is not present.

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step 7
6	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
7	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 10	Go to Step 9

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the HO2S low signal circuit for an open, or high resistance. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* • A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant. Replace the affected HO2S. Refer to Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 or Heated Oxygen Sensor Replacement - Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References. 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 - Vehicle	System OK

DTC P1134 or P1154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from greater than 625 mV to less than 250 mV or from less than 250 mV to greater than 625 mV. If the PCM detects that the difference between the rich-to-lean average transition time and lean-to-rich average transition time is greater than a specified value, DTC P1134 sets for HO2S bank 1 sensor 1, or DTC P1154 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1134 HO2S Transition Time Ratio Bank 1 Sensor 1
- DTC P1154 HO2S Transition Time Ratio Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.

- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 1 second.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the difference between the HO2S rich-to-lean average transition time and the lean-to-rich average transition time is more than a calibrated value for 100 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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 the voltage is varying above and below the specified value, the condition is not present.

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P1134 or P1154

Step	Action	Value(s)	Yes	No
5	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
6	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step 7
7	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* • A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant. Replace the affected HO2S. Refer to Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 or Heated Oxygen Sensor Replacement - Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—

DTC P1134 or P1154				
Step	Action	Value(s)	Yes	No
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 - Vehicle	System OK

DTC P1380

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the antilock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set with the malfunction indicator lamp (MIL) illuminated, and the rough road information is not available due to an ABS malfunction, DTC P1380 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1380 Misfire Detected - Rough Road Data Not Available

Conditions for Running the DTC

- The vehicle speed is greater than 8 km/h (5 mph).
- The engine load is less than 60 percent.
- The engine misfire is detected and DTC P0300 is set with the MIL illuminated.
- The engine speed is less than 7,000 RPM.
- DTC P1380 runs continuously when the above conditions are met.

Conditions for Setting the DTC

An ABS malfunction exists for more than 45 seconds, preventing the PCM from receiving rough road detection data.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory 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 Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

DTC P1380			
Step	**Action**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Does the scan tool display any antilock brake system (ABS) DTCs?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Symptoms - Antilock Brake System

DTC P1381

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the antilock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set with the malfunction indicator lamp (MIL) illuminated and there is no communication with the brake control module, DTC P1381 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1381 Misfire Detected - No Communication With Brake Control Module

Conditions for Running the DTC

- The vehicle speed is above 8 km/h (5 mph).
- The engine speed is below 7,000 RPM.
- The engine load is less than 60 percent.
- Engine misfire is detected and DTC P0300 is set with the MIL illuminated.
- DTC P1381 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM cannot communicate with the brake control module for more than 45 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory 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 Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

DTC P1381			
Step	**Action**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Does the scan tool display any antilock brake system (ABS) DTCs?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Symptoms - Antilock Brake System

DTC P1516

Circuit Description

The predicted throttle position (TP) is compared to the actual throttle position. The two values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the predicted and actual throttle position. DTC P1516 sets if the PCM detects an out of range condition between the predicted and the actual throttle position.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1516 Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance

Conditions for Running the DTC

- DTC P2108 or U0107 is not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- The TAC system is not in the battery saver mode.
- DTC P1516 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TAC module detects that the predicted and the actual throttle positions are not within a calibrated range of each other.

  OR
- The PCM or the TAC module cannot determine the throttle position.

  OR
- Both of the TP sensors are out of range.
- The PCM detects one of the above conditions are present for more than 0.003 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- 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 an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

7. If the TP indicated angle does not follow the movement of the throttle blade and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.

18. Locating and repairing an individual condition may correct more than one DTC.

DTC P1516			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 set?	Go to DTC U0107	Go to Step 3
3	Is DTC P2135 set?	Go to DTC P2135	Go to Step 4
4	**IMPORTANT:** *Low system voltage may cause this DTC to set. Clear DTCs if low system voltage has been experienced.* 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the throttle position (TP) sensor 1 and TP sensor 2 angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return it to the released position. Does the scan tool indicate both angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is released?	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body. 4. Inspect the throttle body and throttle plate for the following conditions which may cause the throttle plate to bind: • Debris--If debris is found, clean the throttle body and repair the source of contamination. • Damage or evidence of tampering--If the throttle body and/or throttle plate is damaged, replace the throttle body. Refer to Throttle Body Assembly Replacement. Did you find and correct the condition?	Go to Step 17	Go to Step 6

DTC P1516			
Step	Action	Yes	No
6	With your hand, slowly open the throttle plate to WOT and back to the closed position several times. Does the throttle plate move smoothly without binding in both directions?	Go to Step 7	Go to Step 14
7	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 4. Turn ON the ignition, with the engine OFF. 5. Open the throttle blade to WOT, then to the closed position by hand. 6. Observe the TP sensor 1 and TP sensor 2 angle parameters with a scan tool. Does the scan tool indicate both angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the plate is moved to the closed position?	Go to Step 8	Go to Step 15
8	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the throttle actuator control motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 17	Go to Step 9
9	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 17	Go to Step 10

DTC P1516			
Step	**Action**	**Yes**	**No**
10	Test each TAC motor circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 17	Go to Step 11
11	1. Disconnect the other TAC module harness connector. 2. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 17	Go to Step 12
12	1. Turn OFF the ignition. 2. Connect the TAC module. 3. Connect a test lamp between the 2 TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	Go to Step 13	Go to Step 5
13	Inspect for poor connections at the TAC motor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 17	Go to Step 14
14	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	Go to Step 17	—
15	Inspect for poor connections at the TAC module harness connectors. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 17	Go to Step 16

DTC P1516			
Step	**Action**	**Yes**	**No**
16	Replace the TAC module. Refer to Throttle Actuator Control Module 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 - Vehicle	System OK

DTC P2101

Circuit Description

The commanded throttle position (TP), based on accelerator pedal position (APP) and possibly other limiting factors, is compared to the actual TP. The two values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the commanded and actual TP. DTC P2101 sets if the PCM detects an out-of-range condition between the commanded and the actual throttle position.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2101 Control Module Throttle Actuator Position Performance

Conditions for Running the DTC

- DTCs P0068, P0601, P0602, P0604, P0606, P1516, P2108, U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.
- The engine is running. OR
- The ignition voltage is more than 8.5 volts with the ignition ON.
- The TAC system is not in the battery saver mode.
- DTC P2101 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the commanded and actual throttle positions are not within 6 percent of each other for more than 0.19 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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 for mechanical concerns or binding that may be temperature related. Components may not move freely in extreme heat or cold due to the presence of contaminants or ice formation.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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 an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. If the TP indicated angle does not follow the movement of the throttle blade and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.

15. Locating and repairing an individual condition may correct more than 1 DTC.

DTC P2101			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 also set?	Go to DTC U0107	Go to Step 3
3	**IMPORTANT:** *The next test must be started within 15 seconds after the ignition is turned ON.* 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the throttle position (TP) sensor 1 and TP sensor 2 angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return the pedal to the released position. Does the scan tool indicate both angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is moved to the released position?	Go to Diagnostic Aids	Go to Step 4

DTC P2101			
Step	**Action**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 5. Turn ON the ignition with the engine OFF. 6. Open the throttle blade to WOT, then to the closed position by hand. 7. Observe the TP sensor 1 and the TP sensor 2 angle parameters with a scan tool. Does the scan tool indicate both angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the throttle plate is moved to the closed position?	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TAC motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to Circuit Testing and to Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 6
6	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to Circuit Testing and to Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 7
7	Test each TAC motor circuit for a short to ground with a DMM. Refer to Circuit Testing and to Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 8

DTC P2101			
Step	**Action**	**Yes**	**No**
8	1. Disconnect the other TAC module harness connector. 2. Remove all jumper wires. 3. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and to Wiring Repairs. Did you find and correct the condition?	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Connect the TAC module. 3. Connect a test lamp between the 2 TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	Go to Step 10	Go to Step 12
10	Inspect for poor connections at the TAC motor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and to Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 14	Go to Step 11
11	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	Go to Step 14	—
12	Inspect for poor connections at the TAC module harness connectors. Refer to Testing for Intermittent Conditions and Poor Connections and to Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 14	Go to Step 13
13	Replace the TAC module. Refer to Throttle Actuator Control (TAC) Module Replacement. Did you complete the replacement?	Go to Step 14	—

DTC P2101			
Step	**Action**	**Yes**	**No**
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 - Vehicle	System OK

DTC P2108

Circuit Description

The throttle actuator control (TAC) module contains data which is essential for proper TAC system operation. The TAC module continuously tests the integrity of this data. When the TAC module is unable to write or read data to and from random access memory (RAM), or the TAC module is unable to correctly read data from the flash memory or an internal TAC module processor fault is detected, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2108 Throttle Actuator Control (TAC) Module Performance

Conditions for Running the DTC

- DTC U0107 is not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is greater than 5.23 volts.
- The communication between the TAC module and the powertrain control module (PCM) must be valid.
- DTC P2108 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The TAC module determines that an internal data test did not pass for between 0.8-60 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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

- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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 an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

Test Description

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

4. Locating and repairing an individual condition may correct more than one DTC.

DTC P2108			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Replace the throttle actuator control (TAC) module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	Go to Step 3	—
3	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 4
4	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2120

Circuit Description

The accelerator pedal position (APP) sensor 1 is a potentiometer type sensor with the following three circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. This DTC incorporates the following diagnostic tests:

- The APP sensor 1 signal circuit voltage out of range
- The accelerator pedal minimum position for the APP sensor 1 out of range
- The 5-volt reference of the APP sensor 1 voltage out of range

If the PCM detects one or more of the APP sensor 1 tests are out of range, DTC P2120 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2120 Accelerator Pedal Position (APP) Sensor 1 Circuit

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- DTC P2120 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the APP sensor 1 signal voltage is less than 0.24 volts or more than 4.49 volts.

  OR
- The accelerator pedal minimum position for the APP sensor 1 is less than 0.24 volts.

  OR
- The 5-volt reference voltage is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 0.1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:
  - The control module commands Reduced Engine Power mode.
  - The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.
  - OR
  - The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  - The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

12. This test isolates whether the short is to another TAC system circuit in the harness or within the TAC module.
26. 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. Remember this if you review the stored information in Capture Info.

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTCs P0120 or U0107 is also set, refer to Diagnostic Trouble Code (DTC) List - Vehicle.* 1. Turn ON the ignition with the engine OFF, and with your foot OFF the accelerator pedal. 2. Observe the accelerator pedal position (APP) sensor 1 voltage with a scan tool. Does the scan tool indicate the APP sensor 1 voltage is within the specified values?	0.24-2.24 V	Go to Step 3	Go to Step 6
3	Depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate APP sensor 1 voltage within the specified values?	0.24-4.49 V	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Select the DTC option using the scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors while monitoring the DTC information. Did this DTC fail this ignition during the above test?	—	Go to Step 24	Go to Step 5

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Continue to observe the DTC information. 2. Depress the accelerator pedal to WOT, then return the pedal to the rest position. Did this DTC fail this ignition during the above test?	—	Go to Step 19	Go to Diagnostic Aids
6	Disconnect the APP sensor harness connector. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	0 V	Go to Step 7	Go to Step 11
7	Connect a test lamp between the APP sensor 1 signal circuit and B+. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	5 V	Go to Step 8	Go to Step 13
8	Test the APP sensor 1 5-volt reference circuit for voltage with a digital multimeter (DMM). Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to Step 10	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body assembly. 4. Turn ON the ignition, with the engine OFF, 5. Rotate the throttle blade by hand to WOT and hold. 6. Test the APP sensor 1 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to Step 21	Go to Step 16
10	1. Connect a fused jumper between the APP sensor 1 low-reference circuit and the APP sensor 1 5-volt reference circuit. 2. Observe the throttle position (TP) sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage at the specified value?	0 V	Go to Step 19	Go to Step 17

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the APP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the APP sensor 1 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 12
12	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 14
14	Test the APP sensor 1 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 15

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
16	1. Turn OFF the ignition. 2. Disconnect the TAC module connector containing the APP sensor circuits. 3. Test the APP sensor 1 5-volt reference circuit for the following conditions with a DMM: • An open • A short to ground • High resistance • Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
17	1. Disconnect the TAC module connector containing the APP sensor circuits. 2. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 18
18	Test the TAC module ground circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20
20	Replace the APP sensor assembly. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
21	Did DTC P0120 set while performing Step 9?	—	Go to DTC P0120	Go to Step 22
22	Inspect for poor connections at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
23	Replace the TAC module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 25	—
24	Repair the intermittent condition as necessary. Refer to Connector Repairs and Wiring Repairs. Did you complete the repair?	—	Go to Step 25	—
25	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 26

DTC P2120				
Step	Action	Value(s)	Yes	No
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2121

Circuit Description

The accelerator pedal position (APP) sensor 1 and APP sensor 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensors a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module signal voltages proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is also low at rest and increases as the pedal is depressed.

This DTC incorporates the following diagnostic tests:

- The APP sensor 1 to APP sensor 2 correlation
- The accelerator pedal minimum position correlation between the APP sensor 1 and APP sensor 2
- The APP sensor 1 signal shorted to a 5-volt reference, ground, or the APP sensor 2 signal

If the PCM detects one or more of the APP sensor 1 tests are out of range, DTC P2121 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2121 Accelerator Pedal Position (APP) Sensor 1 Performance

Conditions for Running the DTC

- DTCs P0606, P2108, or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- DTC P2121 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the APP sensor 1 disagrees with APP sensor 2 by more than 10.5 percent.
- The above condition is present for more than 0.14 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set for a single APP sensor, the following occurs:
  - The control module commands Reduced Engine Power mode.
  - The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.
  - The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  - The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

The numbers below refer to the steps numbers in the diagnostic table.

2. This step determines if a communication condition exists.
5. This step isolates an internal APP sensor failure. The condition may only occur at a certain accelerator pedal position. Monitoring the APP angles for sensor 2 and sensor 3 is an accurate way of verifying the actual position of the pedal. The APP angles for all 3 sensors should be within a few percent of each other. If the pedal is at rest, the APP angle for all 3 sensors should be 0 percent. If the pedal is fully depressed, all APP angles should be 100 percent.
6. The APP sensor 1 shares a common 5-volt reference circuit with the throttle position (TP) sensor 1. Monitoring the TP sensor 1 voltage aids in diagnosing the APP sensor 5-volt reference and low reference circuits.
9. With the TAC module still connected, this test will help determine a short to the signal circuit either within the TAC module or the wiring.
10. This step determines whether the TAC module or a shorted circuit is causing the condition.
19. 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. Remember this if you review the stored information in Capture Info.

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTCs U0107 also set?	—	Go to DTC U0107	Go to Step 3
3	**IMPORTANT:** *DO NOT depress the accelerator pedal.* 1. Start the engine. 2. Observe the DTC information with a scan tool. Did any other throttle actuator control (TAC) module or accelerator pedal position (APP) sensor DTC set except P1125?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	Observe the APP sensor Agree/Disagree parameters with a scan tool. Does the scan tool indicate Disagree for any of the APP Agree/Disagree parameters?	—	Go to Step 6	Go to Step 5
5	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP sensor angles for both APP sensors with a scan tool. 3. Slowly depress the accelerator pedal, stopping at 25, 50, 75, and 100 percent. 4. Slowly release the accelerator pedal, stopping at 75, 50, 25, and 0 percent. Does the scan tool indicate APP sensor 1 angle within 10.5 percent of the APP sensor 2 angle during the above test?	—	Go to Diagnostic Aids	Go to Step 6

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a fused jumper between the APP sensor 1 5-volt reference circuit and ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the throttle position (TP) sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage is at the specified value?	0.0 V	Go to Step 7	Go to Step 11
7	1. Connect a fused jumper between the APP sensor 1 5-volt reference circuit and the APP sensor 1 low reference circuit. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage is at specified value?	0.0 V	Go to Step 8	Go to Step 12
8	1. Connect a fused jumper between the APP sensor 1 signal circuit and the APP sensor 1 5-volt reference circuit. 2. Observe the APP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate APP sensor 1 voltage is near the specified value?	5 V	Go to Step 14	Go to Step 9
9	Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a digital multimeter (DMM). Does the DMM indicate a short to another circuit?	—	Go to Step 10	Go to Step 13
10	1. Turn OFF the ignition. 2. Disconnect both of the TAC module harness connectors. 3. Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
12	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find an open or high resistance?	—	Go to Step 18	Go to Step 15
14	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	Inspect for poor connections at the harness connectors of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Replace the APP sensor assembly. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 18	—
17	Replace the TAC module. Refer to Throttle Actuator Control Module 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. Did 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 - Vehicle	System OK

DTC P2125

Circuit Description

The accelerator pedal position (APP) sensor 2 is a potentiometer type sensor with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed.

This DTC incorporates the following diagnostic tests:

- The APP sensor 2 signal circuit voltage out of range
- The accelerator pedal minimum position for the APP sensor 2 out of range
- The 5-volt reference of the APP sensor 2 tests out of range

If the powertrain control module (PCM) detects one or more of the APP sensor 2 tests are out of range, DTC P2125 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2125 Accelerator Pedal Position (APP) Sensor 2 Circuit

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- DTC P2125 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the APP sensor 2 signal voltage is less than 0.24 volt or more than 4.49 volts.
  - OR
- The accelerator pedal minimum position for the APP sensor 2 is less than 0.24 volts.
  - OR
- The 5-volt reference voltage is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 0.14 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:
  – The control module commands Reduced Engine Power mode.
  – The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.
  – OR
  – The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  – The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. The throttle position (TP) sensor 2 and the APP sensor 2 share a common 5-volt reference source. Diagnose DTC P0220 first if that DTC is also set.
18. This test determines whether or not the TAC module can recognize a change in signal voltage.
19. There are 2 separate 5-volt reference sources within the TAC module. The TP sensor 1 and the APP sensor 1 share one 5-volt reference source. The TP sensor 2 and the APP sensor 2 share another common 5-volt reference source. This test determines whether the signal circuit is shorted to any one of the 5-volt reference circuits. If a short exists, the corresponding sensor voltage will be pulled low.
20. The previous step found the signal circuit and a 5-volt reference circuit shorted together. This test isolates whether the short is in the harness or within the TAC module.
26. 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. Remember this if you review the stored information in Capture Info.

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTCs P0220 or U0107 is also set, refer to Diagnostic Trouble Code (DTC) List - Vehicle and diagnose the applicable DTC first.* 1. Turn ON the ignition, with the engine OFF, and with your foot OFF of the accelerator pedal. 2. Observe the accelerator pedal position (APP) sensor 2 voltage parameter with a scan tool. Does the scan tool indicate the APP sensor 2 voltage is more than the specified value?	0.24 V	Go to Step 3	Go to Step 6
3	Fully depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate the APP sensor 2 voltage is less than the specified value?	4.49 V	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the DTC info with a scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors for the APP sensor while observing the DTC status. 5. If the scan tool indicates this DTC failed this ignition during the above test, repair the intermittent condition as necessary. Refer to Wiring Repairs and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 5

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Slowly depress the accelerator pedal to WOT, then slowly return the pedal to closed throttle while observing the DTC status. Did the scan tool indicate this DTC failed this ignition during the above test?	—	Go to Step 21	Go to Diagnostic Aids
6	1. Disconnect the APP sensor harness connector. 2. Test the APP sensor 2 signal circuit for voltage with a digital multimeter (DMM). Does the DMM indicate the APP sensor 2 signal voltage is within the specified values?	3.94-6.06 V	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the APP sensor circuits. 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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 8
8	Test the APP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 9
9	Test the APP sensor 2 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 10
10	Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Test the APP sensor 2 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to Step 16	Go to Step 12
12	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 13
13	Test the APP sensor 2 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 14r
14	Test the APP sensor 2 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 15
15	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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
16	Measure resistance with a DMM connected between the APP sensor 2 low reference circuit and the APP sensor 1 low reference circuit. Does the DMM indicate resistance within the specified values?	0-5 ohms	Go to Step 18	Go to Step 17

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
17	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 2 low reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
18	1. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. 2. Observe the APP sensor 2 voltage parameter with a scan tool. Does the scan tool indicate APP sensor 2 voltage is at the specified value?	0 V	Go to Step 19	Go to Step 23
19	1. Observe the APP sensor 1, the APP sensor 3, and the TP sensor 2 voltage parameters with a scan tool. 2. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. Did the scan tool indicate a change in voltage in any of the parameters observed during the above test?	—	Go to Step 20	Go to Step 21
20	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connectors. 3. Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
21	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 21

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
22	Replace the APP sensor assembly. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
23	Inspect for poor connections at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
24	Replace the TAC module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 25	—
25	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 26
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2135

Circuit Description

The throttle position (TP) sensor incorporates two ratiometric TP sensors into one housing. TP sensor 1 and TP sensor 2 each have a 5-volt reference circuit supplied by the throttle actuator control (TAC) module. The TAC module supplies each TP sensor with a low reference circuit. Each TP sensor supplies the TAC module with a signal voltage that is proportional to the throttle blade position. Both of the TP signal voltages increase as the throttle blade is opened. The TP sensor 1 and the accelerator pedal position (APP) sensor 1 share a 5-volt reference circuit that is bussed within the TAC module. The TP sensor 2 and the APP sensor 2 share a 5-volt reference circuit that is also bussed within the TAC module. When this DTC sets, the Reduced Engine Power indicator will be displayed.

This DTC incorporates the following diagnostic tests:

- The TP sensor 1 and the TP sensor 2 correlation
- The throttle blade minimum position correlation between the TP sensor 1 and the TP sensor 2
- The TP sensor 1 signal shorted to a 5-volt reference, a ground, or the TP sensor 2 signal circuit

If the powertrain control module (PCM) detects one or more of the TP sensor 1 tests are out of range, DTC P2135 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2135 Throttle Position (TP) Sensor 1-2 Correlation

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- The TP sensor 1 to TP sensor 2 correlation test runs continuously.
- The throttle blade minimum position correlation test runs once after the ignition is turned ON.
- The TP sensor 1 signal circuit short test runs continuously.

Conditions for Setting the DTC

The TP sensor 1 to TP sensor 2 correlation error is more than 6 percent for more than 0.14 second.

OR

The PCM detects a short on the TP sensor 1 signal circuit for more than 0.10 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

21. 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. Remember this if you review the stored information in Capture Info.

DTC P2135			
Step	**Action**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 set?	Go to DTC U0107	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the throttle position (TP) sensor 1 and 2 Agree/Disagree parameter with a scan tool. Does the scan tool TP sensor 1 and 2 Agree/Disagree parameter indicate Disagree?	Go to Step 5	Go to Step 4
4	1. Remove the air inlet duct from the throttle body. 2. Disconnect the throttle body harness connector. 3. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 4. Observe the TP sensor 1 and 2 with a scan tool. 5. Slowly open the throttle blade to wide open throttle (WOT) and back to the closed throttle position several times by hand. Does the TP sensor Agree/Disagree parameter change from Agree to Disagree during the above test?	Go to Step 18	Go to Diagnostic Aids
5	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connectors. 3. Test the TP sensor 1 5-volt reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 6

DTC P2135			
Step	**Action**	**Yes**	**No**
6	Test for a short between the TP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 7
7	Test the TP sensor 1 signal circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 8
8	Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 9
9	Test the TP sensor 1 low reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 10
10	Test for a short between the TP sensor 1 low reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 11
11	Test the TP sensor 2 5-volt reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 12
12	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. Did you find and correct the condition?	Go to Step 20	Go to Step 13

DTC P2135			
Step	**Action**	**Yes**	**No**
13	Test the TP sensor 2 signal circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 14
14	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. Did you find and correct the condition?	Go to Step 20	Go to Step 15
15	Test the TP sensor 2 low reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 16
16	Test for a short between the TP sensor 2 low reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	Go to Step 20	Go to Step 17
17	Inspect for an intermittent and for a poor connection at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 20	Go to Step 18
18	Inspect for an intermittent and for a poor connection at the harness connector of the throttle body. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	Go to Step 20	Go to Step 19
19	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	Go to Step 20	–

DTC P2135

Step	Action	Yes	No
20	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 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2138

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the powertrain control module (PCM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is near the low reference and increases as the pedal is actuated.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2138 Accelerator Pedal Position (APP) Sensor 1-2 Correlation

Conditions for Running the DTC

- The battery voltage is more than 5.23 volts.
- DTCs P2120 or P2125 are not set.
- The accelerator pedal is leaving the idle position.
- DTC P2138 runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value.
- The above condition is met for more than 2 seconds.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after 3 consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC clears after 40 consecutive warm up cycles in which no failures are reported by this diagnostic or any other emission related diagnostic.
- The scan tool clears the MIL/DTC.

Diagnostic Aids

- The PCM compares the signal of each of the accelerator pedal position sensor to each other throughout the entire range of operation. Clear the DTCs and actuate the pedal through the entire range with the ignition ON and the engine OFF.
- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector. Using this kit will prevent damage to the harness connector terminals.
- For intermittent conditions, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. Any circuit faults on either APP sensor 1 or 2 will set one of the DTCs listed. Refer to the appropriate table for diagnosis.

DTC P2138				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the DTC information with a scan tool. Is DTC P0120, P0220, P0641, P0651, P2120, or P2125 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor electrical connector. 3. Disconnect the powertrain control module (PCM). 4. Use a DMM to measure the resistance of the following circuits for each of the APP sensors: • The low reference circuit • The signal circuit • The 5-volt reference circuit Did any of the circuits measure more than the specified value?	5 ohms	Go to Step 5	Go to Step 4
4	1. Test for a short between any of the circuits in the APP sensor harness. 2. Repair the circuit as necessary. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair the high resistance in the circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 7	—
6	Replace the APP sensor. Refer to Accelerator Pedal Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 7	—

DTC P2138				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	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 - Vehicle	System OK

DTC P2636

Circuit Description

The secondary fuel pump is located in the rear fuel tank. The secondary fuel pump is powered by a secondary fuel pump relay. Fuel is transferred from the rear fuel tank to the front fuel tank in order to ensure all of the usable fuel volume is available to the primary fuel pump. The secondary fuel pump relay supply voltage is received from the primary fuel pump relay when the primary fuel pump is energized. This DTC sets when the PCM commands the secondary fuel pump ON and a predetermined change in both the front and rear fuel level sensors does not occur.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2636 Fuel Transfer Pump Flow Insufficient

Conditions for Running the DTC

- DTCs P0461, P0462, P0463, P2066, P2067, P2068 are not set.
- The vehicle speed is 0 km/h (0 mph).
- The engine has been idling for more than 2 minutes and 20 seconds.
- The primary fuel level is less than 60 L (15.8 gal).
- The secondary fuel level is more than 3 L (2.6 gal).

Conditions for Setting the DTC

The PCM does not detect a change of 4 L (1.06 gal), in both the primary and the secondary fuel level sensors, with the secondary pump commanded ON for 120 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

1. A current DTC Last Test Failed clears when the diagnostic runs and passes.
2. A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
3. Clear the DTC with a scan tool.

Test Description

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

2. This step tests the supply voltage circuit of the secondary fuel pump relay. The test lamp should illuminate as the primary fuel pump is commanded ON.
4. This step verifies the secondary fuel pump operation. Listen for an audible sound as the secondary fuel pump relay harness connector is jumpered.
5. This step verifies that there is adequate fuel in the rear fuel tank. The rear fuel tank sensor voltage must be above 1 volt in order to continue.
7. This step tests the secondary fuel pumps ability to transfer fuel. The rear fuel level sensor voltage should decrease while the secondary fuel pump is ON.
8. This step tests for a short to ground on the control circuit of the secondary fuel pump relay. If the test lamp illuminates, a short to ground is indicated.
9. This step tests for a short to voltage on the control circuit of the secondary fuel pump relay. If the test lamp illuminates, a short to voltage is indicated.
10. This step verifies the secondary fuel pump relay operation. An audible click should be heard as the secondary fuel pump relay control circuit is grounded. The secondary fuel pump should turn ON as the fuel pump relay control circuit is grounded.

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Did DTC P0641 or P0651 fail this ignition?	—	Go to Step 3	Go to Step 22
3	Probe the ignition voltage circuit of the secondary fuel pump relay, switch side, with a test lamp connected to a good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 12
4	Connect a 15-amp fused jumper wire between the ignition 1 voltage and secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. Does the secondary fuel pump turn ON?	—	Go to Step 5	Go to Step 16
5	1. Turn OFF the ignition. 2. Remove the jumper wire from the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the rear fuel level voltage parameter with a scan tool. Is the rear fuel level sensor voltage above the specified value?	1 V	Go to Step 7	Go to Step 6
6	Add the specified amount of fuel to the fuel tank. Did you complete the action?	19 L (5 gal)	Go to Step 7	—

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Connect a 15-amp fused jumper wire between the ignition 1 voltage circuit and the secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the rear fuel level sensor voltage parameter with a scan tool. Does the rear fuel level sensor voltage decrease as the secondary fuel pump is operating?	—	Go to Step 8	Go to Step 18
8	1. Turn OFF the ignition. 2. Remove the jumper wire from the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Probe the secondary fuel pump relay control circuit with a test lamp connected to B+. Does the test lamp illuminate?	—	Go to Step 23	Go to Step 9
9	Probe the secondary fuel pump relay control circuit with a test lamp connected to a good ground. Does the test lamp illuminate?	—	Go to Step 27	Go to Step 10

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Turn OFF the ignition. 2. Jumper the following secondary fuel pump relay switch circuits from the secondary fuel pump relay to the secondary fuel pump relay harness connector: • The ignition 1 voltage circuit • The secondary fuel pump supply voltage circuit 3. Jumper the secondary fuel pump relay coil supply circuit to B+. 4. Turn ON the ignition, with the engine OFF. 5. Jumper the control terminal of the secondary fuel pump relay to a good ground. Does the secondary fuel pump turn ON when the fuel pump relay control terminal is grounded?	—	Go to Step 11	Go to Step 19
11	Test the secondary fuel pump relay control circuit for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 21
12	Inspect the PCM 1 fuse. Is the PCM 1 fuse open?	—	Go to Step 13	Go to Step 25
13	Test the ignition 1 voltage circuit of the secondary fuel pump relay for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 14
14	Test the voltage supply circuit of the secondary fuel pump for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 15

DTC P2636				
Step	Action	Value(s)	Yes	No
15	1. Turn OFF the ignition. 2. Install a new fuse. 3. Connect a 15-amp fused jumper wire between the ignition 1 voltage and the secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Inspect the PCM 1 fuse. Is the fuse open?	—	Go to Step 29	Go to Testing for Intermittent Conditions and Poor Connections
16	1. Lower the rear fuel tank. 2. Disconnect the secondary fuel pump harness connector. 3. Probe the voltage supply circuit of the secondary fuel pump with a test lamp connected to a good ground. Does the test lamp illuminate?	——	Go to Step 17	Go to Step 26
17	Probe the ground circuit of the secondary fuel pump with a test lamp connected to B+. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 24
18	Inspect the fuel line between the primary and secondary fuel tanks for a restriction. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29
19	Test for an intermittent and for a poor connection at the harness connector of the secondary fuel pump relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 28

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	Test for an intermittent and for a poor connection at the harness connector of the secondary fuel pump. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29
21	Test for an intermittent and for a poor connection at the harness connector of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 30
22	Repair the open supply voltage circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
23	Repair the short to ground in the control circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
24	Repair the open ground circuit of the secondary fuel pump. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
25	Repair the open ignition voltage circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
26	Repair the open supply voltage circuit of the secondary fuel pump. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Repair the short to voltage on the control circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
28	Replace the secondary fuel pump relay. Did you complete the replacement?	—	Go to Step 31	—
29	Replace the rear fuel level sensor assembly. Refer to Fuel Sender Assembly Replacement. Did you complete the replacement?	—	Go to Step 31	—
30	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 31	—
31	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 32
32	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2A01 or P2A04

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream.

The HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 are used for catalyst monitoring. This diagnostic runs once per ignition cycle. This diagnostic consists of two tests, a passive test and an intrusive test. During the passive test, if the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 voltage transitions less than 349 mV and greater than 710 mV, the DTC will pass for this ignition cycle. If the DTC does not pass during the passive test, the intrusive test will begin. During the intrusive test, the control module will force the air-to-fuel ratio rich and/or lean. The control module then waits for a predicted response from the HO2S. If the HO2S voltage transitions less than 349 mV or greater than 710 mV, the DTC will pass for this ignition cycle. If the control module does not receive the expected response from the HO2S, DTC P2A01 will set for HO2S bank 1 sensor 2, or DTC P2A04 will set for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2A01 HO2S Performance Bank 1 Sensor 2
- DTC P2A04 HO2S Performance Bank 2 Sensor 2

Conditions for Running the DTC

DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1134, P1153, P1154 are not set.

Passive Test

- The engine is running.
- The above conditions are met for 2 seconds.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Intrusive Test

- The engine run time is more than 218 seconds.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Engine Speed parameter is between 900-5,000 RPM.
- The MAF Sensor parameter is between 5-100 g/s.
- The Vehicle Speed parameter is between 24-131 km/h (15-82 mph).
- The Short Term FT Bank 1 and Bank 2 parameter is between -4 and +4 percent.
- The maximum number of intrusive attempts is less than 100.
- The above conditions are met for 3 seconds.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

1. The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 did not transition less than 349 mV and greater than 710 mV during the passive test.
2. One of the following tests fail:

   Lean Intrusive Test

   – The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is greater than 349 mV for 60 seconds.

   – The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is less than 300 mV.

   Rich Intrusive Test

   – The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is less than 710 mV for 60 seconds.

   – The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is greater than 600 mV.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
2. 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. If the voltage does not change more than the specified value, the condition is present.

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 8

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 10	Go to Step 11
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 14
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 15	Go to Step 13
13	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
15	1. The HO2S may be detecting a rich exhaust condition, a lean exhaust condition, or the HO2S may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S - Any water intrusion into the HO2S connector - An exhaust leak between the HO2S and the engine - Any vacuum leaks - Engine oil contaminated with fuel - An incorrect fuel pressure--Refer to Fuel System Diagnosis. - Any lean or rich fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. - An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16

DTC P2A01 or P2A04				
Step	Action	Value(s)	Yes	No
16	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	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 21

DTC P2A01 or P2A04				
Step	Action	Value(s)	Yes	No
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC U0107

Circuit Description

The throttle actuator control (TAC) module and the powertrain control module (PCM) communicate via a dedicated serial data circuit. This serial data circuit is separate from any other serial data circuit on the vehicle. Accurate transmitting and receiving of serial data requires not only good circuit integrity, but also adequate system voltage. This diagnostic test monitors the accuracy of the serial data transmitted between the TAC module and the PCM. If the PCM detects a loss of data or invalid data, DTC U0107 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC U0107 Lost communication with Throttle Actuator Control (TAC) Module

Conditions for Running the DTC

- The ignition switch is in the Run position.
- The ignition voltage is more than 5.23 volts.
- DTC U0107 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects invalid or missing serial data messages for more than 0.83 second.

Action Taken When the DTC Sets

1. The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
2. 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.
3. The control module commands the TAC system to operate in the Reduced Engine Power mode.
4. A message center or an indicator displays Reduced Engine Power.
5. 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

IMPORTANT:
Reprogramming the PCM may cause a communication error between the PCM and the TAC. If the PCM detects a communication error, DTC U0107 sets. Clear any DTCs from the memory that may have been set by Reprogramming.

- DTC U0107 sets if the battery voltage is low. If the customer concern is slow cranking or no crank because battery voltage is low, ignore DTC U0107. Clear any DTCs from memory that may have set from the low battery voltage condition.
- DTC U0107 sets when there is a short to B+ on the TAC module ground circuit. Inspect the fuses for the circuits that are in the TAC module harness, i.e. cruise, brake. An inspection of the fuses may lead you to the circuit that is shorted to the TAC module ground circuit.
- DTC U0107 sets if the TAC module ignition feed circuit is shorted to a B+ supply circuit. The TAC module stays powered-up when the ignition switch is turned OFF. When the ignition switch is turned ON, the TAC module is powered-up before the PCM. DTC U0107 sets because no communication is detected by the TAC module from the PCM. Inspect related circuits for being shorted to a B+ supply circuit.
- Inspect the TAC module power and ground circuits and the TAC module/PCM serial data circuits for intermittent connections.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.

- When the TAC module detects a problem 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 an individual condition may correct more than one DTC. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. This step determines if the ignition relay is supplying a voltage to the ETC fuse.
5. Increasing the engine speed to 3,000 RPM aids in locating a shorted throttle actuator motor control circuit. Depending on the polarity of the throttle actuator motor transistors, this DTC may not set with a fault in the control circuits. The throttle actuator motor is a bi-directional DC motor. Raising the engine speed changes the polarity of the transistors in the throttle actuator motor. This occurs because one set of the transistors is low, 0 volts, and the other set is high, B+. Therefore, if one set of transistors is at a low voltage and the corresponding circuit is shorted low, DTC P1518 will not set. When the polarity of the transistors change, this DTC sets. If this DTC does not fail this ignition, continue to monitor this DTC status while moving related harnesses and connectors.
29. Locating and repairing an individual condition may correct more than one DTC.

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Remove the cover from the underhood electrical center. 3. Test both sides of the ETC fuse with a test lamp connected to ground. Does the test lamp illuminate on at least one side of the fuse?	—	Go to Step 3	Go to Ignition Relay Diagnosis
3	1. Turn OFF the ignition 2. Test for voltage at the ETC fuse with a test lamp connected to ground. Does the test lamp illuminate?	—	Go to Step 22	Go to Step 4
4	Connect a scan tool. Is DTC P0604 also set?	—	Go to DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610	Go to Diagnostic Aids
5	**IMPORTANT:** *If the driver information center (DIC) is displaying Reduced Engine Power, go to Step 6.* 1. Start the engine. 2. Increase the engine speed to 3,000 RPM, if possible. 3. Monitor the DTC Info option using the scan tool. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 6	Go to Step 8

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for voltage at both throttle actuator motor control circuits with a DMM. Does the DMM indicate voltage on both circuits above the specified value?	1 V	Go to Step 12	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module connectors. 3. Test both throttle actuator motor control circuits for continuity to ground with a DMM. Does the DMM indicate continuity to ground?	—	Go to Step 10	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the ETC fuse. 3. Test the TAC side of the fuse terminal for continuity to ground with a DMM. Refer to Diagnostic Aids for terminal identification table. Does the DMM indicate continuity to ground?	—	Go to Step 9	Go to Step 11
9	1. Disconnect the TAC module 16-way harness connector. 2. Test the TAC side of the fuse terminal for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 24
10	1. Disconnect the TAC module 16-way harness connector. 2. Test the throttle actuator motor control circuits for a short to ground at the TAC module 16-way harness connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 24

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way harness connector. 3. Test the TAC module ignition feed circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 24
12	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for a short to voltage at both throttle actuator motor control circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 13
13	1. Turn OFF the ignition. 2. Disconnect the TAC module 10-way harness connector. 3. Test for a short between each throttle actuator motor control circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 14
14	Test for an open or high resistance in the TAC module ground circuit with a DMM. Refer to Circuit Testing and to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 15
15	Test for voltage on the serial data circuits at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage within the specified values for both circuits?	0-4.5 V	Go to Step 16	Go to Step 18

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	1. Turn OFF the ignition. 2. Test both serial data circuits at the TAC module 16-way harness connector for continuity to ground with a DMM. Does the DMM indicate OL for both circuits?	—	Go to Step 20	Go to Step 17
17	1. Disconnect the powertrain control module (PCM) connector containing the TAC module serial data circuits. 2. Test both serial data circuits at the TAC module 16-way connector for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 18
18	Test for a short between both serial data circuits and all other circuits at the PCM and TAC module harness connectors with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 19
19	Test for a short to voltage on both serial data circuits at the TAC module 16-way connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 15
20	1. Disconnect the PCM connector that contains the TAC module serial data circuits. 2. Test each serial data circuit between the TAC module 16-way harness connector and the PCM harness connector for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 21

DTC U0107

Step	Action	Value(s)	Yes	No
21	1. Connect the PCM. 2. Turn ON the ignition. 3. Test for voltage on the serial data circuit at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage at the specified value?	0 V	Go to Step 25	Go to Step 24
22	1. Turn OFF the ignition. 2. Disconnect the 16-way TAC module harness connector. 3. Test the TAC module ignition feed circuit for a short to battery voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 23
23	1. Turn ON the ignition. 2. Test both TAC motor circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 24
24	Test for poor connections at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 28	Go to Step 26
25	Test for poor connections at the PCM harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
26	Replace the TAC module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 28	—

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 28	—
28	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 29
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

8.1L ENGINE DIAGNOSTICS

Begin the system diagnosis with Diagnostic System Check - Vehicle. The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and the codes' statuses

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Data List

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Engine Scan Tool Data List only after the following is determined:

- The Engine Controls Diagnostic Check is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine.

IMPORTANT

A scan tool that displays faulty data should not be used. The scan tool problem should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to Symptoms - Engine Controls for diagnosis.

The column labeled Data List indicates where a parameter can be located on the scan tool. Refer to the scan tool operating manual for the exact locations of the data lists. The following is a description of each term listed:

All: The parameter is in all of the data lists indicated below.

Eng 1: Engine Data 1 List

Eng 2: Engine Data 2 List

EE: Enhanced Evaporative Emission (EVAP) Data

EGR: Exhaust Gas Recirculation (EGR) Data

FF/FR: Freeze Frame/Failure Records

FT: Fuel Trim Data List

HO2S: HO2S Data List

MF: Misfire Data List

TAC: Throttle Actuator Control (TAC) Data

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories Off			
4WD Signal (if equipped)	Eng 2	Enabled/Disabled	Disabled
4WS Low Signal (if equipped)	Eng 2	Enabled/Disabled	Disabled
A/C Clutch Feedback Signal	Eng 2	Relay ON/Relay OFF	Relay OFF
A/C Compressor Cycling Switch	Eng 2	Low Pressure/Normal	Normal
A/C High Pressure Recirculation Switch	Eng 2	High Pressure/Normal	Normal
A/C Relay Command	Eng 1/Eng 2/EGR/MF	ON/OFF	OFF
A/C Request Signal	Eng 2	Yes/No	No
AIR Relay Command	FT	On/OFF	Varies
APP Average	TAC	Counts	Varies
APP Indicated Angle	Eng 1/Eng 2/EE/EGR/FT/HO2S/ TAC/CC	0-100%	0%
APP Sensor 1	TAC	0-100%	0%
APP Sensor 1	TAC	0-5 V	0.4-0.9 V
APP Sensor 2	TAC	0-100%	0%
APP Sensor 2	TAC	5-0 V	4.5-4.1 V
APP Sensor 1 and 2	TAC	Agree/Disagree	Agree
BARO	Eng 1/EE/EGR/FT	kPa	65-104 kPa varies w/ altitude
CMP Sensor-High to Low	Eng 2	Counts	Varies
CMP Sensor-Low to High	Eng 2	Counts	Varies
Cold Startup	Eng 2/EE	Yes/No	Varies
Coolant Level Switch	Eng 2	OK/Low	OK
Cruise Control Active	Eng 1/TAC/CC	Yes/No	No
Cruise Disengage 1-8 History	CC	History/No History	Varies
Cruise On/Off Switch	TAC/CC	ON/OFF	OFF
Cruise Release Brake Pedal Switch	CC	Applied/Released	Released
Cruise Resume/Accel. Switch	TAC/CC	ON/OFF	OFF
Cruise Set/Coast Switch	TAC/CC	ON/OFF	OFF
Current Gear (4 speed only)	Eng 1/Eng 2/EGR/FT	0-4	1
Cycles of Misfire Data	MF	0-100 Counts	Varies

Decel. Fuel Cutoff	HO2S	Active/Inactive	Inactive
Desired EGR Position	Eng 1/EGR/MF	0-100%	0%
Desired EGR Position	EGR	0-5 V	Less than 1.3 V
Desired Idle Speed	Eng 1/Eng 2/TAC/EE	RPM	PCM Controlled
DTC Set This Ignition	Eng 1/Eng 2/EE/FT/HO2S/CC	Yes/No	No
ECT Sensor	Eng 1/Eng 2/EE/EGR/FT/HO2S/MF	-39 to +140°C (-38 to +284°F)	88-105°C (190-221°F)
EGR Learned Minimum Position	EGR	0-5 V	Varies
EGR Position Sensor	EGR	0-5 V	Less than 1.3 V
EGR Position Sensor	MF/ EGR/Eng 1	0-100%	0%
Engine Load	All	0-100%	1-4% @ Idle 7-10% @ 2500 RPM
Engine Oil Level Switch (if equipped)	Eng 2	OK/Low	OK
Engine Oil Life Remaining	Eng 2	0-100%	Varies
Engine Run Time	All	Hrs/Min/Sec	Varies
Engine Speed	All	0-10000 RPM	500-700 RPM
EVAP Purge Solenoid Command	Eng 1/EE/FT	0-100%	0-25%
EVAP Test Result	EE	Passed/Failed/No Result	Varies
EVAP Vent Solenoid Command (if equipped)	Eng 1/EE/FT	Not Venting/Venting	Venting
Fuel Level Sensor	EE	0-5 V	0.7-2.5 V
Fuel Level Sensor Rear Tank (if equipped)	EE/ Eng 1	0-5 V	0.7-2.5 V
Fuel Tank Level Remaining	EE	Gal/L	Varies
Fuel Tank Level Remaining	EE	0-100%	Varies
Fuel Tank Pressure (FTP) Sensor (if equipped)	Eng 1/EE	-32.7 to +13.96 mm/Hg (-17.4 to +7.5 in/H2O)	Varies
FTP Sensor (if equipped)	EE	0-5 V	Varies
Fuel Tank Rated Capacity	EE	L (Gal)	Varies with fuel tank option
Fuel Trim Cell	Eng 1/EE/FT	0-23	16-20
Fuel Trim Learn	Eng 1/EE/FT	Enabled/Disabled	Enabled (may toggle)
Generator F Terminal Signal	Eng 2	%	Varies
Generator L Terminal Signal Command	Eng 2	ON/OFF	ON
HO2S Bank 1 Sensor 1	Eng 1/EE/FT/HO2S	mV	10-1000 mV and Varying

HO2S Bank 1 Sensor 2 (if equipped)	Eng 1/EE/FT/ HO2S	mV	10-1000 mV and Varying
HO2S Bank 2 Sensor 1	Eng 1/EE/FT/HO2S	mV	10-1000 mV and Varying
HO2S Bank 2 Sensor 2 (if equipped)	Eng 1/EE/FT/HO2S	mV	10-1000 mV and Varying
HO2S Heater Bn 1 Sen. 1	HO2S	amps	0.72-0.78 amps
HO2S Heater Bn 1 Sen. 2	HO2S	amps	0.72-0.78 amps
HO2S Heater Bn 2 Sen. 1	HO2S	amps	0.72-0.78 amps
HO2S Heater Bn 2 Sen. 2	HO2S	amps	0.72-0.78 amps
IAT Sensor	Eng 1/Eng 2/EE/EGR/FT/HO2S	-39 to +140°C (-38 to +284°F)	Depends on ambient temperature
Ignition 1 Signal	Eng 1/Eng 2/EE/EGR/FT/TAC/CC	0-25.5 V	11.5-14.5 V
Inj. PWM Bank 1 Average	Eng 2/FT/MF	ms	2-6 ms
Inj. PWM Bank 2 Average	Eng 2/FT/MF	ms	2-6 ms
Knock Retard	Eng 1/EGR	0-16°	0°
Long Term FT Avg. Bn1	FT	%	Near 0%
Long Term FT Avg. Bn2	FT	%	Near 0%
Long Term FT Bank 1	Eng 1/Eng 2/EE/FT/HO2S	%	Near 0%
Long Term FT Bank 2	Eng 1/Eng 2/EE/FT	%	Near 0%
Loop Status	Eng 1/Eng 2/EE/EGR/FT/HO2S	Open/Closed	Closed
Low Oil Lamp Command (if equipped)	Eng 2	ON/OFF	OFF
MAF Sensor	Eng 1/Eng 2/EGR/FT/HO2S/MF/EE/ TAC	0-665 g/s	1-9 g/s @ Idle (depends on altitude) 15-26 g/s @ 2500 RPM (depends on altitude)
MAFSensor	Eng 2	0-31999 Hz	2000-3000 Hz
MAP Sensor	Eng 1/Eng 2/EGR// FT/HO2S/MF/ EE/TAC	10-105 kPa	20-48 kPa
MAP Sensor	Eng 1/Eng 2	0-5 V	1.0-2.0 V Varies with altitude
MIL Command	Eng 2	ON/OFF	OFF
Mileage Since DTC Cleared	Eng 2	Miles/Km	Varies
Misfire Current Cyl. 1-8	MF	0-255 Counts	0
Misfire History Cyl. 1-8	MF	0-65535 Counts	0
PCM Reset	Eng 1/Eng 2/EGR/EE/FT	Yes/No	No
PCM/VCM in VTD Fail Enable (if equipped)	Eng 1	Yes/No	No

Power Enrichment	Eng 1/Eng 2/HO2S	Yes/No	No
Reduced Engine Power	Eng 1/EGR/TAC/CC	Active/Inactive	Inactive
Short Term FT Avg. Bn1	FT	%	Near 0%
Short Term FT Avg. Bn2	FT	%	Near 0%
Short Term FT Bank 1	Eng 1/Eng 2/EE/FT/HO2S	%	Near 0%
Short Term FT Bank 2	Eng 1/Eng 2/EE/FT/HO2S	%	Near 0%
Spark	Eng 1/Eng 2/FT/HO2S/MF	Degrees	15-20°
Start Up ECT	Eng 2/EE// FT	°C/°F	Varies
Stop Lamp Pedal Switch	Eng 2/TAC/CC	Applied/Released	Released
TAC/PCM Communication Signal	Eng 1/TAC/CC	OK/Fault	OK
TCC Brake Pedal Switch	Eng 1/Eng 2	Applied/Released	Released
TCC Enable Solenoid Command (4L80-85E only)	Eng 1/Eng 2/MF/FF-FR	ON/OFF	OFF
TCC PWM Solenoid Command (4L80-85E only)	Eng 2	ON/OFF	OFF
TFP Sw. (4L80-85E only)	Eng 2/EGR/FT	Transmission Gear Position	Varies
TP Desired Angle Eng 1/Eng 2/EE/EGR/TAC/CC	0-100%	3-4.5%	
TP Indicated Angle	All	0-100%	3-7%
TP Sensor 1	TAC	0-100%	3%
TP Sensor 1	TAC	0-5 V	0.4-0.9 V
TP Sensor 2	TAC	0-100%	3%
TP Sensor 2	TAC	5-0 V	4.8-4.3 V
TP Sensors 1 and 2	TAC	Agree/Disagree	Agree
TR Switch (4L80-85E only)	Eng 2/EGR/FT	Transmission Gear Position	Park
Vehicle Speed Sensor	All	km/h-mph	0
VTD Auto Learn Timer (if equipped)	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable (if equipped)	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable Until Ign. Off (if equipped)	Eng 1	Yes/No	No
Warm-Ups w/o Emission Faults	Eng 2	0-255 Counts	Varies
Warm-Ups w/o Non-Emission Faults	Eng 2	0-255 Counts	Varies

Scan Tool Data Definitions

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters available on the scan tool. The list is in alphabetical order. A given parameter may appear in any one of the data lists. In some cases, the parameter may appear more than once or in more than one data list in order to group certain related parameters together.

4WD Low Signal

This parameter displays the state of the transfer case based on the signal from the four wheel drive (4WD) low switch. The scan tool will display Enabled or Disabled. Enabled indicates the transfer case is in 4WD low gear and the 4WD low switch is closed, completing the low signal circuit. Disabled indicates the transfer case is not in 4WD low gear and the 4WD low switch is open.

4WD Signal

This parameter displays the state of the transfer case based on the signal from the front axle indicator switch. The scan tool will display Enabled or Disabled. Enabled indicates the front axle is locked in four wheel drive and the front axle indicator switch is closed, supplying voltage to the controller on the axle switch signal circuit. Disabled indicates the transfer case is not in four wheel drive and the front axle indicator switch is open.

A/C Clutch Feed Back Signal

This parameter displays the state of the air conditioning (A/C) compressor clutch based on the signal from the switched side of the A/C clutch relay. The scan tool will display Relay On or Relay Off. Relay On indicates the A/C clutch relay has closed, allowing voltage to the A/C compressor clutch. Relay Off indicates the A/C clutch relay is open and the A/C compressor clutch is not engaged.

A/C Compressor Cycling Switch

This parameter displays the state of the air conditioning (A/C) compressor cycling switch as determined by the control module. The scan tool will display Normal or Low Pressure. Normal indicates the A/C system has enough refrigerant to close the A/C compressor cycling switch, allowing the A/C compressor to engage. Low Pressure indicates the A/C refrigerant system has low pressure and the A/C compressor cycling switch is open.

A/C Sec. High Pressure Switch

The scan tool displays High Pressure or Normal. This parameter displays the state of the A/C secondary high pressure switch. The A/C secondary high pressure switch is normally open.

A/C Relay Command

This parameter displays the commanded state of the air conditioning (A/C) clutch relay control circuit. The scan tool will display ON or OFF. ON indicates the A/C clutch relay control circuit is being grounded by the control module, alllowing voltage to the A/C compressor clutch. OFF indicates the A/C clutch relay is not being commanded on by the control module.

A/C Request Signal

This parameter displays the state of the air conditioning (A/C) request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls. The scan tool will display Yes or No. Yes indicates the control module is receiving a request from the HVAC system to ground the A/C clutch relay control circuit, engaging the A/C compressor clutch. No indicates the control module is not receiving a request from the HVAC system to ground the A/C clutch relay control circuit.

AIR Relay Command

This parameter displays the commanded state of the secondary air injection (AIR) pump relay control circuit. The scan tool will display ON or OFF. ON indicates the AIR pump relay control circuit is being grounded by the control module, allowing voltage to the AIR pump. OFF indicates the AIR pump relay is not being commanded on by the control module.

APP Average

This parameter displays the average of the 3 accelerator pedal position (APP) sensors as calculated by the throttle actuator control (TAC) module. The APP average is a range of values indicating a low number when the accelerator pedal is not depressed to a high number when the accelerator pedal is fully depressed. This value is listed in counts.

APP Indicated Angle

This parameter displays the angle of the accelerator pedal as calculated by the control module using the signals from the accelerator pedal position sensors. The APP indicated angle is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

APP Sensor 1

This parameter displays the angle of the accelerator pedal position (APP) sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

APP Sensor 1

This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 1 of the APP sensor assembly. APP sensor 1 is a range of values indicating a low voltage when the accelerator pedal is not depressed to a high voltage when the accelerator pedal is fully depressed.

APP Sensor 1 and 2

This parameter displays the results of a control module test that compares the signals from the accelerator pedal position (APP) sensors 1 and 2. The scan tool will display Agree or Disagree. Agree indicates that APP sensor 1 and APP sensor 2 voltages correspond to the same accelerator pedal position. Disagree indicates that APP sensor 1 and APP sensor 2 voltages correspond to different accelerator pedal positions.

APP Sensor 2

This parameter displays the angle of the accelerator pedal position (APP) sensor 2 as calculated by the control module using the signal from the APP sensor 2. APP sensor 2 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

APP Sensor 2

This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of values indicating a low voltage when the accelerator pedal is not depressed to a high voltage when the accelerator pedal is fully depressed.

BARO

The scan tool displays a range of 10-105 kPa. The barometric pressure (BARO) reading is determined from the manifold absolute pressure (MAP) sensor signal. The powertrain control module (PCM) monitors the MAP signal during key up or wide open throttle (WOT) conditions. The barometric pressure (BARO) compensates for altitude differences.

CMP Sensor-High to Low

The scan tool displays 0-65,535 counts. The counts increment as the powertrain control module (PCM) detects the camshaft position (CMP) sensor signal voltage going from high to low.

CMP Sensor-Low to High

The scan tool displays 0-65,535 counts. The counts increment as the powertrain control module (PCM) detects the camshaft position (CMP) signal voltage going from low to high.

Cold Start Up

The scan tool displays Yes or No. A cold start-up is when the engine coolant temperature (ECT) rises above a predetermined temperature during an ignition cycle. The next ignition cycle the ECT should be below a predetermined temperature. Also the ECT and the intake air temperature (IAT) are less than 50°C (122°F) and are within 3°C (5°F) of each other at start-up. When the above is true, the scan tool displays Yes.

Coolant Level Switch

The scan tool displays OK or Low. This parameter indicates when the engine coolant level is low. The scan tool displays Low when the powertrain control module (PCM) detects the engine coolant level is low.

Cruise Control Active

The scan tool displays Yes or No. When the cruise control switch is ON and the set/coast switch is activated, the scan tool displays yes. When the cruise control switch is ON and the set/coast switch is released, the scan tool displays No.

Cruise Disengage 1-8 History

This parameter displays the last 8 cruise control disengages in order from 1 to 8. The control module will disengage the cruise control for up to 20 different conditions.

Cruise On/Off Switch

The scan tool displays ON or OFF. When you activate the cruise control switch, the scan tool displays ON. The switch, when in the ON position, sends a signal voltage to the throttle actuator control (TAC) module. This allows all other functions of the cruise control. When you turn OFF the cruise control switch, the scan tool displays OFF.

Cruise Release Brake Pedal Switch

This parameter displays the state of the Cruise Release Brake Pedal Switch as determined by the control module. The scan tool will display Released or Applied. Released indicates the brake pedal is not being pushed down , allowing the cruise control to be enabled. Applied indicates the brake switch is being applied, disabling cruise control operation.

Cruise Resume/Accel

The scan tool displays ON or OFF. When the cruise control switch is in the ON position and the Resume/Accel switch is activated, the scan tool displays ON. When the Resume/Accel switch is released, the scan tool displays OFF.

Cruise Set/Coast

The scan tool displays ON or OFF. When the cruise control switch is in the ON position and the Set/Coast switch is activated, the scan tool displays ON. When the Set/Coast switch is released the scan tool displays OFF.

Current Gear

The scan tool displays 0-4. The scan tool displays which gear the transmission is in. An illegal transmission position displays 9.

Cycles of Misfire Data

The scan tool displays a range of 0-100. The powertrain control module (PCM) counts the number of misfire tests during 200 engine revolutions.

Decel. Fuel Shutoff

The scan tool displays Active or Inactive. The scan tool displays Active when the powertrain control module (PCM) shuts off fuel flow through the fule injectors because of a deceleration condition.

Desired EGR Position

The scan tool displays 0-100 percent. This parameter displays the desired position of the exhaust gas recirculation (EGR) pintle as requested by the powertrain control module (PCM). This parameter should be very close to actual EGR position.

Desired EGR Position

The scan tool displays 0-5 volts. The commanded exhaust gas recirculation (EGR) is the EGR pintle position commanded by the powertrain control module (PCM).

Desired Idle Speed

The scan tool displays a range of 0-3,187 RPM. The powertrain control module (PCM) commands the desired idle speed. The PCM compensates for various engine loads based on engine coolant temperature (ECT) in order to keep the engine at the desired speed.

DTC Set This Ignition

The scan tool displays Yes or No. This parameter indicates if a DTC set during the current ignition cycle.

ECT Sensor

The scan tool displays a range of -39 to +140°C (-38 to +284°F). The powertrain control module (PCM) applies 5 volts to the engine coolant temperature (ECT) sensor circuit. The sensor is a thermistor which changes internal resistance as the engine temperature changes. When the sensor is cold, internal resistance high, the PCM senses a high signal voltage and interprets the voltage as a cold engine. As the sensor warms, internal resistance decreases, the voltage signal decreases and the PCM interprets the lower voltage as a warm engine.

EGR Learned Minimum Position

Represents the learned voltage that the controller uses to determine whether or not the EGR valve is fully closed.

EGR Position Sensor

The scan tool displays 0-5 volts. This parameter displays the actual exhaust gas recirculation (EGR) pintle position in voltage.

EGR Position Sensor

The scan tool displays a range of 0-100 percent. The powertrain control module (PCM) supplies a pulse width modulated (PWM) duty cycle to control the exhaust gas recirculation (EGR) valve. Zero percent indicates no EGR flow. One hundred percent indicates full EGR flow.

Engine Load

The scan tool displays a range of 0-100 percent. The powertrain control module (PCM) calculates the engine load from engine speed and mass airflow (MAF) sensor readings. The engine load increases with an increase in RPM or airflow.

Engine Oil Level Switch

The scan tool displays OK or Low. This parameter indicates when the engine oil level is low. The scan tool displays Low when the powertrain control module (PCM) detects the engine oil level is low.

Engine Oil Life Remaining

The scan tool displays 0-100 percent. This display represents the engine oil life index that is calculated and maintained by the powertrain control module (PCM).

Engine Run Time

The scan tool displays Hours, Minutes and Seconds. This displays the amount of engine run time for the current ignition cycle. When you cycle the ignition OFF, the timer resets to zero.

Engine Speed

The scan tool displays a range of 0-10,000 RPM. The powertrain control module (PCM) computes engine speed from the ignition reference pulses. The engine speed should remain close to desired idle under various engine loads with the engine idling.

EVAP Purge Solenoid Command

The scan tool displays a range of 0-100 percent. The powertrain control module (PCM) supplies a pulse width modulated (PWM) duty cycle to control the evaporative emission (EVAP) purge solenoid valve. 0 percent indicates no purge. 100 percent indicates full purge.

EVAP Test Result

The scan tool displays if the evaporative emission (EVAP) test has passed or failed. The scan tool displays pass when the powertrain control module (PCM) determines that the EVAP diagnostic has passed. The scan tool displays fail when the PCM determines that the EVAP diagnostic has failed.

EVAP Vent Solenoid Command

The scan tool displays Venting or Not Venting. The evaporative emission (EVAP) canister vent valve is normally open. The powertrain control module (PCM) commands the EVAP canister vent valve closed, during testing of the EVAP system.

Fuel Level Sensor

The scan tool displays 0-5 volts. The scan tool displays below 1 volt for an empty tank, and close to 2.5 volts for a full tank.

Fuel Tank Level Remaining

The scan tool displays in liters or gallons the amount of fuel remaining in the fuel tank.

Fuel Tank Level Remaining

The scan tool displays 0-100 percent. The scan tool displays in percentage the amount of fuel remaining in the fuel tank.

Fuel Tank Pressure Sensor

The scan tool displays -32.7 to +13.96 mm/Hg (-17.4 to +7.5 in H2O. This parameter indicates the pressure vacuum inside of the fuel tank. A negative value indicates a vacuum. A positive value indicates a pressure.

Fuel Tank Pressure Sensor

The scan tool displays 0-5 volts. The scan tool displays in voltage the pressure inside of the fuel tank.

Fuel Tank Rated Capacity

The scan tool displays the capacity of the fuel tank in liters or gallons.

Fuel Trim Cell

The scan tool displays a range of 0-23. The powertrain control module (PCM) determines from the manifold absolute pressure (MAP) and RPM inputs which fuel trim cell to operate the engine in. The fuel trim cell displayed on the scan tool is the cell that the engine is operating under.

Fuel Trim Learn

The scan tool displays Enabled or Disabled. When conditions are appropriate for enabling long term fuel trim corrections, the scan tool displays Enabled. This indicates that the long term fuel trim is responding to the short term fuel trim. If the scan tool displays Disabled, then long term fuel trim will not respond to changes in Short Term fuel trim.

Generator F Terminal Signal Command

The scan tool displays 0-100 percent. The display shows generator F terminal duty cycle in percent from 0-100 percent. The generator is able to produce the desired voltage by varying the duty cycle of the field current.

Generator L Terminal Signal Command

The scan tool displays ON or OFF. The scan tool displays OFF if the powertrain control module (PCM) does not detect a correct voltage on the L-terminal circuit. The scan tool displays ON under normal operating conditions.

HO2S Bank 1 Sensor 1

The scan tool displays a range of 0-1,106 mV. The heated oxygen sensor (HO2S) bank 1 sensor 1 parameter represents the fuel control exhaust oxygen sensor output voltage. The voltage fluctuates constantly within a range between 10-1,000 mV, while operating in Closed Loop.

HO2S Bank 1 Sensor 2

The scan tool displays a range of 0-1,106 mV. The heated oxygen sensor (HO2S) bank 1 sensor 2 parameter represents the fuel control exhaust oxygen sensor output voltage. The voltage fluctuates constantly within a range between 10-1,000 mV, while operating in Closed Loop.

HO2S Bank 2 Sensor 1

The scan tool displays a range of 0-1,106 mV. The heated oxygen sensor (HO2S) bank 2 sensor 1 parameter represents the exhaust oxygen sensor output voltage. The voltage fluctuates constantly within a range between 10-1,000 mV, while operating in Closed Loop.

HO2S Bank 2 Sensor 2

The scan tool displays a range of 0-1,106 mV. The heated oxygen sensor (HO2S) bank 2 sensor 2 parameter represents the fuel control exhaust oxygen sensor output voltage. The voltage fluctuates constantly within a range between 10-1,000 mV, while operating in Closed Loop.

HO2S Heater Bn 1 Sen. 1

This parameter displays the current through the control module when the bank 1 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bn 1 Sen. 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bn 1 Sen. 2

This parameter displays the current through the control module when the bank 1 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bn 1 Sen. 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bn 2 Sen. 1

This parameter displays the current through the control module when the bank 2 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bn 2 Sen. 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bn 2 Sen. 2

This parameter displays the current through the control module when the bank 2 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bn 2 Sen. 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

IAT Sensor

The scan tool displays a range of -39 to +140°C (-38 to +284°F). The powertrain control module (PCM) converts the resistance of the intake air temperature (IAT) sensor to degrees. The PCM uses the IAT in order to adjust fuel delivery and spark timing according to incoming air density.

Ignition 1 Signal

The scan tool displays 0-25.5 volts. The ignition 1 represents the system voltage measured by the powertrain control module (PCM) at the ignition feed circuit.

Inj. PWM Average Bank 1 and Bank 2

The scan tool displays a range of 0-1,000 milliseconds. The injector average indicates the amount of time the powertrain control module (PCM) commands each injector ON during each engine cycle. A longer injector pulse width causes more fuel to be delivered. The injector pulse width increases with an increased engine load.

Knock Retard

The scan tool displays a range of 0.0-16 degrees. Knock retard indicates the amount of spark the powertrain control module (PCM) removes from the ignition control (IC) spark advance in response to the signal from the knock sensors (KS).

Long Term FT Avg. Bn1 and Bn2

The scan tool displays percentage. This parameter indicates the average of all long term fuel trim cells. The short term fuel trim cells are rated, for the amount of which they are used. For example, an idle cell is rated higher than a wide open cell. If a fueling malfunction occurs in the idle cell and the wide open cell, the average would be more affected by the idle cell than the wide open cell. A negative value significantly below 0 percent indicates that the fuel system is rich and fuel delivery is being reduced. A positive value significantly more than 0 percent indicates that a lean condition exists and the powertrain control module (PCM) compensates by adding fuel. When the average of the cells reach a predetermined high or low, a fuel trim DTC sets.

Long Term FT Bank 1 and Bank 2

The scan tool displays percentage. The powertrain control module (PCM) derives the long term fuel trim from the short term fuel trim value. The long term fuel trim represents a long term correction of fuel delivery. A value of 0 percent indicates that fuel delivery requires no compensation in order to maintain the PCM commanded air/fuel ratio. A negative value significantly below 0 percent indicates that the fuel system is rich and the PCM is reducing the fuel delivery. A positive value significantly more than 0 percent indicates that a lean condition exists and the PCM compensates by adding fuel. Fuel trim values at maximum authority indicates an excessively rich or lean system.

Loop Status

The scan tool displays Open or Closed. Closed Loop indicates that the powertrain control module (PCM) is controlling fuel delivery according to oxygen sensor (HO2S) voltage. In Open Loop, the PCM ignores the HO2S voltage and bases the amount of fuel to be delivered on throttle position (TP) sensor, engine coolant, and mass air flow (MAF) sensor inputs only.

Low Oil Lamp Command

The scan tool displays ON or OFF. The scan tool displays On when the powertrain control module (PCM) detects that there is a low oil level condition. The low oil lamp is then commanded ON by the PCM.

MAF Sensor

The scan tool displays a range of 0-655 g/s. The mass air flow (MAF) is the MAF input frequency converted to grams of air per second. This indicates the amount of air entering the engine.

MAF Sensor

The scan tool displays a range of 0-31,999 Hz. The mass air flow (MAF) sensor is a hot wire type air flow sensor. The powertrain control module (PCM) converts current draw needed by the MAF to keep the hot wires at a constant into a frequency signal. The scan tool displays this frequency in a hertz signal.

MAP Sensor

Scan Tool Range 10-105 kPa/0-5 volts. The manifold absolute pressure (MAP) sensor measures the change in the intake manifold pressure from engine load, and speed changes. As intake manifold pressure increases, the intake vacuum decreases resulting in a higher MAP sensor voltage and kPa reading. The powertrain control module (PCM) uses the MAP sensor signal for updating the barometric pressure (BARO) reading and as an enabling factor for several of the diagnostics.

MIL Command

The scan tool displays On or Off. The scan tool indicates if the powertrain control module (PCM) has commanded the MIL ON.

Mileage Since DTC Cleared

The scan tool displays Kilometers or Miles. This parameter indicates the distance traveled since an emission DTC cleared. The powertrain control module (PCM) stores this information in the Freeze Frame/Failure Records memory.

Misfire Current Cyl. #1 - #8

The scan tool displays a range of 0-255 counts. The misfire current counters increment at a rate according to the number of possible misfires the powertrain control module (PCM) detects on each cylinder during the last 200 cylinder firing events. The counters may normally display some activity, but the activity should be nearly equal for all the cylinders.

Misfire History Cyl. #1 - #8

The scan tool displays a range of 0-65,535 counts. The misfire history counters display the total level of misfire that has been detected on each cylinder. The misfire history counters will not update or show any activity until a misfire DTC P0300 has become active. The misfire history counters will update every 200 cylinder firing events.

PCM Reset

The scan tool displays Yes or No. This parameter indicates when the internal powertrain control module (PCM) resets. The scan tool displays YES when an internal PCM reset occurred. The scan tool displays NO under the normal operating conditions.

PCM/VCM in VTD Fail Enable

The powertrain control module (PCM) displays Yes or No. The scan tool displays Yes if the body control module (BCM) and the PCM lose communications with each other after the BCM sends the correct password. The scan tool displays No if the BCM is communicating the correct password to the PCM.

PNP Switch

The scan tool displays Park/Neutral / In Gear. This parameter indicates the range selection of automatic transmission equipped vehicles. The parameter will display Park/Neutral for the Park or Neutral position of the gear selector. The parameter will display In Gear for the Reverse, Drive, or Low positions of the gear selector.

Power Enrichment

The scan tool displays YES or NO. Yes indicates that the powertrain control module (PCM) has detected conditions appropriate to operate in Power Enrichment mode. The PCM will command Power Enrichment mode when a large increase in throttle position and load is detected. While in Power Enrichment, the PCM will increase the amount of fuel delivered by entering Open Loop and increasing the injector pulse width. This is done to prevent a possible sag or hesitation from occurring during acceleration.

Power Take Off (PTO) Enable

The scan tool displays YES or NO. Yes indicates that the power take off (PTO) has been engaged and No indicates that the PTO has been disengaged.

Reduced Engine Power

The scan tool displays Active or Inactive. The scan tool displays Active when the powertrain control module (PCM) receives a signal from the throttle actuator control (TAC) module that a TAC system fault is occurring. The PCM limits the engine power.

Short Term FT Avg. Bn1 and Bn2

The scan tool displays percentage. This parameter indicates the average of the short term fuel trim cells. The short term fuel trim cells are rated for the amount of which they are used. For example, the powertrain control module (PCM) rates an idle cell higher than a wide open cell. If a fueling malfunction occurs in the idle cell and the wide open cell, the idle cell would affect more than the wide open cell. A negative value significantly below 0 percent indicates that the fuel system is rich and the PCM is reducing the fuel delivery. A positive value significantly more than 0 percent indicates that a lean condition exists and the PCM is compensating by adding fuel. When the average of the cells reach a predetermined high or low, a fuel trim DTC sets.

Short Term FT Bank 1 and Bank 2

The scan tool displays percentage. The short term fuel trim represents a short term correction to fuel delivery by the powertrain control module (PCM) in response to the amount of time the fuel control oxygen sensor voltage spends above or below the 450 mV threshold. If the O2S voltage mainly remains less than 450 mV, indicating a lean air/fuel mixture, short term fuel trim increases into the positive range above 0 percent. The PCM adds fuel. If the O2S voltage stays mainly above the threshold, the short term fuel trim decreases below 0 percent into the negative range. The PCM reduces the fuel delivery in order to compensate for the indicated rich condition. Under certain conditions such as an extended idle and a high ambient temperature, the canister purge may cause the short term fuel trim to read in the negative range during normal operation. The fuel trim values at maximum authority may indicate an excessively rich or lean system.

Spark

The scan tool displays a range of -64 to +64 degrees. The scan tool displays the amount of degrees the powertrain control module (PCM) commands the spark advance on the ignition control (IC) circuit. The PCM computes the desired spark advance using the following: (1) ECT, (2) Engine speed (RPM), (3) Load, (4) Vehicle speed. The PCM adjusts the timing.

Start Up ECT

The scan tool displays a range of -39 to +140°C (-38 to +284°F). The scan tool displays the engine coolant temperature (ECT) at the time the engine was started. The powertrain control module (PCM) uses start-up ECT for certain DTCs.

Stop Lamp Pedal Switch

The scan tool displays Applied or Released. This parameter indicates the state of the brake switch circuit input. The scan tool displays Applied when you apply the vehicle brakes. The scan tool displays Released when you release the vehicle brakes.

TAC/PCM Communication Signal

The scan tool displays OK or Fault. If the communication between the throttle actuator control (TAC) module and the powertrain control module (PCM) is interrupted the scan tool displays Fault. The scan tool displays OK under the normal operating conditions.

TCC Brake Pedal Switch

The scan tool displays Applied or Released. This parameter indicates the state of the (TCC/CC) brake switch circuit input. Open indicates 0 voltage input, brake switch open, brake pedal applied. Closed indicates a B+ voltage input, brake switch closed, brake pedal released. When you apply the vehicle brakes, the scan tool displays Applied. The TCC and cruise control disengages. When you release the vehicle brakes, the scan tool displays Released. This allows the cruise control to be resumed and the torque converter clutch to engage.

TCC Enable Solenoid Command

The scan tool displays Enabled or Disabled. The scan tool displays Enabled when the electrical system supplies a voltage to the TCC enable solenoid.

TCC PWM Solenoid Command

The scan tool displays 0-100 percent. This parameter is the commanded state of the torque converter clutch (TCC) pulse width modulated (PWM) solenoid. The scan tool displays 100 percent when the commanded state of the solenoid is ON. The scan tool displays 0 percent when the solenoid is OFF.

TFP Sw.

The scan tool displays Park/Neutral, Reverse, Drive 4, Drive 3, Drive 2, or Low. Trans range represents the decoded status of the four inputs from the transmission internal mode switch assembly. The combination of the transmission inputs indicates the position of the transmission manual valve.

TP Desired Angle

The scan tool displays 0-100 percent. The powertrain control module (PCM) indicates the desired throttle angle commanded by the vehicle operator.

TP Indicated Angle

The scan tool displays 0-100 percent. The TP indicated angle displays in percentage the amount of throttle opening.

TP Sensor 1

The scan tool displays 0-100 percent. The scan tool displays the amount of throttle opening in percentage. Closed throttle displays 0 percent and wide open throttle (WOT) displays near 100 percent.

TP Sensor 1

The scan tool displays 0-5 volts. The scan tool displays the amount of throttle opening in volts. Closed throttle displays about 1 volt and wide open throttle (WOT) displays above 3.5 volts.

TP Sensor 2

The scan tool displays 0-100 percent. The scan tool displays the amount of throttle opening in percentage. Closed throttle displays 0 percent and wide open throttle (WOT) displays near 100 percent.

TP Sensor 2

The scan tool displays 5-0 volts. The scan tool displays the amount of throttle opening in volts. Closed throttle displays about 4 volts and wide open throttle (WOT) displays below 1.5 volts.

TP Sensors 1 and 2

The scan tool displays Agree or Disagree. When the throttle actuator control (TAC) module receives a signal voltage from one of the throttle position sensors not in proper relationship to the other, the scan tool displays Disagree. The scan tool displays No under normal operating conditions.

TR Switch

The scan tool displays the transmission gear position.

Vehicle Speed Sensor

The scan tool displays km/h and mph. The vehicle speed sensor (VSS) signal is converted into km/h and mph for display on the scan tool.

VTD Auto Learn Timer

The scan tool displays Active/Inactive. The auto learn timer is the indication if the vehicle theft deterrent (VTD) system is in the learn mode and has not timed out.

VTD Fuel Disabled

The scan tool displays Active/Inactive. If the powertrain control module (PCM) has not received the correct password from the body control module (BCM), the PCM disables the fuel system and the scan tool displays Active. The scan tool displays Inactive under normal operating conditions.

VTD Fuel Disable Until Ignition Off

The scan tool displays Yes or No. With the ignition ON and a vehicle theft deterrent (VTD) code present, the scan tool displays Yes.

Warm Ups w/o Emission Faults

The scan tool displays a range of 0-255. This parameter counts the number of warm up cycles without an emission fault present. The counter increments to 255 and rolls back to 0 unless a fault occurs. If a fault occurs, the counter reverts back to 0 until the fault is corrected. Clearing the information with a scan tool or a loss of power to the powertrain control module (PCM) also resets the counter to 0.

Warm Ups w/o Non - Emission Faults

The scan tool displays a range of 0-255. This parameter counts the number of warm up cycles without a non-emission fault present. The counter increments to 255 and rolls back to 0 unless a fault occurs. If a fault occurs, the counter reverts back to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the powertrain control module (PCM) also resets the counter to 0.

Scan Tool Output Controls

Scan Tool Special Function	Additional menu Selections	Description
Crankshaft Position Variation Learn	--	Enables the powertrain control module (PCM) to learn the variations in the crankshaft position (CKP) system. The PCM will learn the variations once the following conditions are met:• Engine coolant temperature (ECT) is more than a specified value. • All instructions on the scan tool have been completed. • The accelerator pedal is smoothly applied until the fuel cut-OFF- as specified on the scan tool is achieved- and then immediately released. The PCM learns the variation values on the deceleration from fuel cut-OFF.
Cylinder Power Balance	Fuel System	Enables/Disables a cylinder by turning OFF the fuel injector to the cylinder. The fuel injector is normally enabled. The PCM disables the fuel injector when the following conditions are met: • All instruction on the scan tool are completed • Stabilized engine speed • The fuel injector is selected When the Disable is selected the PCM turns the injector OFF for 30 seconds. During this period the engine operates with a misfire.
Engine Speed Control	TAC System	Activates the throttle activation control (TAC) system to change engine RPM. The normal commanded state is None. To enable the RPM control all instruction on the scan tool must be completed. The system will increase or decrease the RPM within a range of 350-2000 RPM. The set step value changes the RPM by increments of 25 RPM- 100 RPM and 500 RPM. The system remains in the commanded state until cancelled by the scan tool.
EGR Solenoid	Engine Output Controls	Activates the exhaust gas recirculation (EGR) solenoid that controls EGR valve position. The normal commanded state is None. The system will increase or decrease the amount of EGR opening by 10 percent increments within a range of 0-100 percent. The system remains in the commanded state for a maximum of 30 seconds or until cancelled by the scan tool. Once the 30 second timer has expired output control is not allowed for 60 seconds. If the engine is running too much EGR will result in a rough idle and/or stalling.

Scan Tool Special Function	Additional menu Selections	Description
EVAP Purge Solenoid	Engine Output Controls/ EVAP System	Activates the evaporative emission (EVAP) purge valve. The normal commanded state is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within a range of 0-100 percent. The system remains in the commanded state until cancelled by the tool or the fuel tank pressure (FTP) exceeds 32 mm Hg (17 in H20).
EVAP Purge/Seal	Engine Output Controls/ EVAP System	This control enables two functions. One function increases or decreases the amount of purge by changing the duty cycle of the purge valve and commanding the vent ON- non-venting. The normal commanded state of both valves is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within a range of 0-100 percent. The second function seals the system after using the purge function to obtain a specific amount of FTP. When activated the purge valve is commanded to 0 percent and the vent valve is commanded ON- non-venting. Both functions remain in the commanded state until one of the following conditions occurs: • Cancelled by the tool • The FTP exceeds 32 mm Hg (17 in H20)
EVAP System Seal	Engine Output Controls/ EVAP System	Commands the purge valve OFF
EVAP Test	Service Bay Test	Activates the Service Bay Test to verify the integrity of the EVAP system. The scan tool initiates the test when the following conditions are met: • All instruction on the scan tool have been completed • ECT is less than a specified value • No DTCs are set
EVAP Vent Solenoid	Engine Output Controls/ EVAP System	Activates the EVAP vent solenoid. The normal commanded state is None. When commanded ON- the vent valve switches to non-venting. The system remains in the commanded state until one of the following conditions occurs: • Cancelled by the tool • Purge is greater than 0 percent and the fuel tank pressure exceeds 32 mm Hg (17 in H20)
Fuel Injector Balance	Fuel System	Enables the fuel injector in order to verify proper fuel injector flow. The PCM will pulse the selected injector when the following conditions are met: • All instruction on the scan tool completed • Fuel injector selected • Key ON

Scan Tool Special Function	Additional menu Selections	Description
Fuel Pump	Engine Output Controls	Controls the fuel pump relay. The normal commanded state is None. When commanded ON/OFF
Fuel Trim Enable	Fuel System	Disables the PCMs ability to learn new fuel trim parameters. The system remains in the commanded state until cancelled by the scan tool.
Fuel Trim Reset	Fuel System	Activates the reset of fuel trim data in all of the fuel trim cells.
Loop Status	Engine Output Controls	Controls the system loop status. The commanded states include None
Malfunction Indicator Lamp	Engine Output Controls	Controls the malfunction indicator lamp (MIL). The commanded states include None
Misfire Graph	—	Graphs the accumulated misfires occurring in each cylinder. The scan tool allows for a reset of the misfire graph.
O2S Heater Control	Engine Output Controls	Activates the HO2S Heater. The commanded states include None- ON and OFF. The normal commanded state is None. On a cold engine

DTC P0030, P0036, P0050, or P0056

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the engine control module (ECM).

The ECM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The ECM monitors the voltage on the HO2S heater low control circuit for heater fault diagnosis. If the ECM detects that the HO2S heater low control circuit voltage is not within a specified range, DTC P0030 sets for HO2S bank 1 sensor 1, DTC P0036 sets for HO2S bank 1 sensor 2, DTC P0050 sets for HO2S bank 2 sensor 1, or DTC P0056 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0030 HO2S Heater Control Circuit Bank 1 Sensor 1
- DTC P0036 HO2S Heater Control Circuit Bank 1 Sensor 2
- DTC P0050 HO2S Heater Control Circuit Bank 2 Sensor 1
- DTC P0056 HO2S Heater Control Circuit Bank 2 Sensor 2

Conditions for Running the DTC

- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the affected HO2S heater low control circuit is not within a specified range for 6 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.

7. With no fault present, the test lamp will blink once per second.

DTC P0030, P0036, P0050, or P0056				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1.Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S Heater Current parameter with a scan tool. Is the HO2S Heater Current parameter within the specified range?	0.25-3.125 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0030, P0036, P0050, or P0056				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 1.Command the HO2S heaters ON with a scan tool. 2. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0030, P0036, P0050, or P0056				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition? G	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P0030, P0036, P0050, or P0056				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to the following: • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2 Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2A or O2B fuse, if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21

DTC P0030, P0036, P0050, or P0056				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0053, P0054, P0059, or P0060

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. The PCM calculates the heater resistance on a cold start. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater calculated resistance is not within the expected range, the following DTCs will set:

- DTC P0053 for HO2S Bank 1 Sensor 1
- DTC P0054 for HO2S Bank 1 Sensor 2
- DTC P0059 for HO2S Bank 2 Sensor 1
- DTC P0060 for HO2S Bank 2 Sensor 2

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0053 HO2S Heater Resistance Bank 1 Sensor 1
- DTC P0054 HO2S Heater Resistance Bank 1 Sensor 2
- DTC P0059 HO2S Heater Resistance Bank 2 Sensor 1
- DTC P0060 HO2S Heater Resistance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P2610 are not set.
- The ignition is OFF for more than 10 hours.
- The Engine Coolant Temperature (ECT) Sensor parameter is between -30 and +45°C (-22 and +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is started.
- This diagnostic runs one time per valid cold start once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up for 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 number below refers to the step number on the diagnostic table.

9. With no fault present, the test lamp will blink once per second.

DTC P0053, P0054, P0059, or P0060				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	.25-3.125 A	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.	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0053, P0054, P0059, or P0060				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0053, P0054, P0059, or P0060				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0053, P0054, P0059, or P0060				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. Refer to the following: • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2 Did you complete the replacement?	—	Go to Step 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—

DTC P0053, P0054, P0059, or P0060				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	1. Replace the O2A or O2B fuse, if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?		Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0054 or P0060 (w/6.0L)

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM calculates the heater resistance on a cold start. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater calculated resistance is not within an expected range, DTC P0054 sets for HO2S bank 1 sensor 2, or DTC P0060 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0054 HO2S Heater Resistance Bank 1 Sensor 2
- DTC P0060 HO2S Heater Resistance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0128, P2610 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 and +45°C (-22 and +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is started.

Conditions for Setting the DTC

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up for one 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 number below refers to the step number on the diagnostic table.

7. With no fault present, the test lamp will blink once per second.

DTC P0054 or P0060 (6.0L ENGINE)				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check – Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.375 A	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 Testing for Intermittent Conditions and Poor Connections
4	Inspect the O2B fuse. Is the O2B fuse open?	—	Go to Step 5	Go to Step 6
5	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8

DTC P0054 or P0060 (6.0L ENGINE)				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 17	Go to Step 17
7	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 9	Go to Step 10
8	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0054 or P0060 (6.0L ENGINE)				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit • The ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 16	Go to Step 14
10	Is the test lamp on steady?	—	Go to Step 11	Go to Step 12
11	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
12	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13
13	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0054 or P0060 (6.0L ENGINE)				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
17	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 20	—
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21

DTC P0054 or P0060 (6.0L ENGINE)				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0068

Circuit Description

The powertrain control module (PCM) uses the following readings in order to calculate the predicted mass air flow (MAF) rate:

- The throttle position (TP)
- The barometric (BARO) pressure
- The intake air temperature (IAT)
- The engine revolutions per minute (RPM)

The PCM compares the predicted MAF value to the actual MAF value, and to the speed density calculation in order to verify the proper throttle operation.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0068 Throttle Body Air Flow Performance

Conditions for Running the DTC

- DTCs P0601, P0602, P0604, P0606, P1516, P2101, P2108 or U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.
- The engine operates longer than 1 second.
- The engine speed is greater than 500 RPM.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the difference between the actual MAF and the speed density calculated air flow is greater than expected.
- All of the above conditions met 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 throttle blade for being broken, bent, or missing.
- Inspect the TP sensor for proper installation. A sensor that is mis-aligned could set this DTC.
- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Physically and visually inspect the throttle body assembly and correct any problems that you observe. Manually move the throttle blade from closed to wide open throttle (WOT). You should not need to use excess force. The throttle blade should move smoothly through the full range and then should independently return to a slightly open position.

- 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. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. Locating and repairing an individual condition may correct more than one DTC.

DTC P0068				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC P0101, P0102, P0103, P0107, P0108, P0112, P0113, P1111, or P1112 set?		Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	**IMPORTANT:** *If any of the conditions listed below exist, replace the throttle body assembly. Refer to Throttle Body Assembly Replacement.* Inspect the throttle body for the following: • Loose or damaged throttle blade • Cracked or bent throttle shaft Did you find and correct the condition?	—	Go to Step 4	Go to Diagnostic Aids
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 DTC run and pass?	—	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 - Vehicle	System OK

DTC P0101

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. The PCM uses the following sensor inputs to calculate a predicted MAF value:

- The manifold absolute pressure (MAP) sensor
- The intake air temperature (IAT) sensor
- The engine speed revolutions per minute (RPM)

The PCM compares the actual MAF sensor frequency signal to the predicted MAF value. This comparison will determine if the signal is stuck based on a lack of variation, or is too low or too high for a given operating condition. If the PCM detects the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value DTC P0101 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0101 Mass Air Flow (MAF) Sensor Performance

Conditions for Running the DTC

- DTCs P0068, P0102, P0103, P0106, P0107, P0108, P0120, P0220, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P2135 are not set.
- The engine is cranking or running.
- The ignition 1 signal is between 11-18 volts.
- The throttle position (TP) indicated angle is less than 95 percent.
- The change in the TP indicated angle is less than 5 percent.
- The MAP sensor is less than 80 kPa.
- The change in the MAP sensor is less than 3 kPa.
- The above conditions are met for 1.5 seconds.
- DTC P0101 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value for more 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.

Diagnostic Aids

- Inspect the harness of the MAF sensor to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays
  - Any motors
- A low minimum air rate through the sensor bore at idle or during deceleration may cause this DTC to set. Inspect for any vacuum leak downstream of the MAF sensor.
- Inspect for any contamination or debris on the sensing elements of the MAF sensor.
- Inspect the air induction system for any water intrusion. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A wide open throttle acceleration from a stop should cause the MAF Sensor parameter on the scan tool to increase rapidly. This increase should be from 7-12 g/s at idle to 230 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A high resistance of 15 ohms or more on the ignition 1 voltage circuit may cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- The barometric pressure (BARO) that is used to calculate the predicted mass air flow value is initially based on the MAP sensor at key ON. When the engine is running, the BARO value is continually updated near wide open throttle. A skewed MAP sensor will cause the calculated mass air flow value to be inaccurate and may result in a no start condition. The value shown for the MAP Sensor parameter varies with the altitude. With the ignition ON and the engine OFF, 101 kPa is the approximate value near sea level. This value will decrease by approximately 3 kPa for every 305 meters (1,000 feet) of altitude.
- A high resistance on the 5-volt reference circuit of the MAP sensor may cause this DTC to set.
- A high resistance on the low reference circuit of the MAP sensor may cause this DTC to set.
- If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step will determine if the MAP sensor pressure is within the proper range for a given altitude.
6. This step will determine if the MAP sensor voltage is within the proper range at idle.
7. This step will determine if the MAP sensor responds properly to the change in manifold pressure.
8. This step will determine if the TP sensors are operating properly.
9. This step will determine if any mechanical faults have caused this DTC to set.
10. This voltage drop test will determine if high resistance has caused this DTC to set.

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the scan tool display any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Attempt to start the engine. Does the engine start?	—	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 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 5	Go to Diagnostic Aids

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low or very high pressure and/or temperature may cause a reading to be slightly out of range.* 1. Turn ON the ignition, with the engine OFF. 2. Observe the Manifold Absolute Pressure (MAP) Sensor kPa parameter with a scan tool. 3. The MAP sensor pressure should be within the specified range for your altitude. Refer to Altitude vs Barometric Pressure. Is the MAP sensor pressure within the specified range as indicated on the Altitude vs. Barometric Pressure table?	—	Go to Step 6	Go to DTC P0106
6	Observe the MAP sensor parameter with a scan tool. 1. Start the engine. 2. Does the MAP Sensor parameter decrease?	—	Go to Step 7	Go to DTC P0106
7	1. Idle the engine. 2. Observe the MAP Sensor parameter with a scan tool. 3. Increase the engine speed slowly to 3,000 RPM and then back to idle. Does the MAP Sensor parameter change smoothly and gradually through the specified range of the test?	—	Go to Step 8	Go to DTC P0106

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition with the engine OFF. 3. Observe the throttle position (TP) Indicated Angle parameter with a scan tool. 4. Depress the accelerator pedal completely. Is the TP Indicated Angle parameter within the specified range?	98-100%	Go to Step 9	Go to DTC P0120
9	1. Turn OFF the ignition. 2. Inspect for the following conditions: – A restricted or collapsed air intake duct – A misaligned air intake duct – A dirty or deteriorating air filter element – Any objects blocking the air inlet screen of the mass air flow (MAF) sensor – Any contamination or debris on the sensing elements of the MAF sensor – Any water intrusion in the induction system – Any vacuum leak downstream of the MAF sensor – A skewed or stuck intake air temperature (IAT) sensor–Refer to Temperature vs Resistance – A MAF sensor harness that is routed too close to any aftermarket accessories–Refer to Checking Aftermarket Accessories. – Any type of restriction in the exhaust system. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Disconnect the harness connector of the MAF sensor. 2. Measure the battery voltage with a DMM. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to Circuit Testing. 5. Connect a DMM to the probe of the test lamp and a good ground. Refer to Measuring Voltage Drop. Is the voltage within 0.50 volts of the specified value?	B+	Go to Step 11	Go to Step 12
11	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Repair the high resistance in the ignition 1 voltage circuit of the MAF sensor. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
13	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor 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

DTC P0101				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0102

Circuit Description

The mass air flow (MAF) sensor is an airflow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal in order to provide the correct fuel delivery for a wide range of engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage in order to produce a frequency based on inlet air flow through the sensor bore. The frequency varies within a range of around 2,000 Hertz at idle to about 10,000 Hertz at maximum engine load. If the PCM detects a frequency signal lower than the possible range of a properly operating MAF sensor, DTC P0102 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The engine speed is more than 400 RPM.
- The ignition 1 signal is more than 8 volts.
- The above conditions are met for more than 1 second.
- DTC P0102 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is less than 1,200 Hertz for more than 0.6 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.

Diagnostic Aids

Inspect for the following conditions:

- An incorrectly routed harness--Inspect the harness of the MAF sensor in order to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays
  - Any motors
  - Any aftermarket accessories--Refer to Checking Aftermarket Accessories.

- A low minimum air rate through the sensor bore may cause this DTC to set at idle or during deceleration. Inspect for any vacuum leaks downstream of the MAF sensor.
- A wide open throttle (WOT) acceleration from a stop should cause the MAF Sensor g/s parameter on the scan tool to increase rapidly. This increase should be from 6-12 g/s at idle to 230 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A resistance of 15 ohms or more on the ground circuit or the ignition 1 circuit of the MAF sensor can cause this DTC to set.

If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step will determine if any mechanical faults have caused this DTC to set.
7. This voltage drop test will determine if high resistance has caused this DTC to set.
9. This step verifies the voltage signal from the PCM to the MAF sensor connector.
10. This step tests the signal circuit of the MAF sensor for a short to another 5-volt reference circuit.
11. This step will determine if the PCM is able to process the frequency signal that it receives from the MAF sensor.
14. This step will determine which portion of the circuit or which component is shorted to ground.
17. This step verifies that the signal circuit is not shorted to any other PCM circuit.

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Observe the Mass Air Flow (MAF) Sensor parameter with a scan tool. Is the MAF Sensor parameter less than the specified value?	1,200 Hz	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. Observe the MAF Sensor parameter with a scan tool. 2. Move the harness and the connector of the MAF/intake air temperature (IAT) sensor. Does the movement of the harness or the connector affect the MAF Sensor parameter?	—	Go to Step 20	Go to Step 5

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Inspect for the following conditions: – A restricted or collapsed air intake duct – A misaligned air intake duct – A dirty or deteriorating air filter element – Any objects blocking the air inlet screen of the MAF/IAT sensor – Any water intrusion in the Induction System – A restricted Exhaust System – Any contamination or debris on the sensing elements of the MAF sensor Did you find and correct the condition?	—	Go to Step 28	Go to Step 6
6	Inspect the fuse in the ignition 1 voltage circuit of the MAF sensor. Is the fuse open?	—	Go to Step 14	Go to Step 7
7	1. Turn ON the ignition, with the engine OFF. 2. Measure the battery voltage with a DMM. 3. Disconnect the MAF/IAT sensor. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to Probing Electrical Connectors. 5. Connect the DMM to the probe of the test lamp and a good ground. Refer to Measuring Voltage Drop and Circuit Testing. Is the voltage within 0.50 volts of the specified value?	B+	Go to Step 8	Go to Step 21

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	**IMPORTANT:** *All electrical components and accessories must be turned OFF.* 1. Turn OFF the ignition for 60 seconds to allow the control modules to power down. 2. Measure the resistance from the ground circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	5 ohms	Go to Step 9	Go to Step 22
9	1. Turn ON the ignition, with the engine OFF. 2. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 10	Go to Step 13
10	1. Connect a 3-amp fused jumper wire between the signal circuit of the MAF sensor and a good ground. Refer to Circuit Testing. **IMPORTANT:** *Running the engine with the MAF/IAT sensor disconnected may also set DTC P0113.* 2. Start the engine. 3. Observe the DTC Information with a scan tool. Do any additional DTCs set?	—	Go to Step 24	Go to Step 11

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Connect the voltage supply and ground the black lead of the J 38522 Variable Signal Generator to the vehicle. 3. Connect the red lead of the J 38522 to the signal circuit of the MAF sensor. Refer to Probing Electrical Connectors. 4. Set the Duty Cycle switch of the J 38522 to Normal. 5. Set the Frequency switch of the J 38522 to 5 K. 6. Set the Signal switch of the J 38522 to 5 V. 7. Start the engine and allow it to idle. 8. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter within the specified range?	4,950-5,025 Hz	Go to Step 12	Go to Step 15
12	**IMPORTANT:** *An abnormal resistance on the signal circuit will disable the MAF sensor frequency before the voltage starts to drop out of the correct parameter of 4.8-5.2 volts.* 1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the MAF sensor signal circuit for a high resistance and for a short to the IAT signal circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 18
13	Is the voltage less than the specified value?	4.8 V	Go to Step 15	Go to Step 16
14	**IMPORTANT:** *The ignition 1 voltage circuit of the MAF sensor is spliced to other components of the vehicle.* Test the ignition 1 voltage circuit for a short to ground. Refer to Testing for Short to Ground and Wiring Repairs. Did you find and correct the condition? -	–	Go to Step 28	—

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Test the signal circuit between the PCM and the MAF sensor for the following conditions: - A high resistance - An open circuit - A short to ground Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 17
16	**IMPORTANT:** *Disconnecting the PCM connectors may eliminate the short to voltage if the signal circuit is shorted to another PCM circuit.* 1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	0 V	Go to Step 23	Go to Step 17
17	Measure the resistance from the signal circuit of the MAF sensor to all other circuits at both PCM connectors with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	∞ ohms	Go to Step 25	Go to Step 19
18	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 26

DTC P0102				
Step	Action	Value(s)	Yes	No
19	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
20	Repair the wiring or the connector as needed. Refer to Wiring Repairs and Connector Repairs. Did you complete the repair?	—	Go to Step 28	—
21	Repair the high resistance or the open in the MAF sensor ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
22	Repair the high resistance or the open in the MAF sensor ground circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
23	Repair the short to voltage in the MAF sensor signal circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—
24	Repair the short between the MAF sensor signal circuit and the 5-volt reference circuit for which the DTC set. Refer to Wiring Repairs Did you complete the repair?	—	Go to Step 28	—
25	Repair the circuits that are shorted together. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 28	—

DTC P0102				
Step	**Action**	**Value(s)**	**Yes**	**No**
26	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 28	—
27	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 28	—
28	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 29
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0103

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. If the PCM detects the frequency signal is more than the possible range of a correctly operating MAF sensor DTC P0103 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The engine speed is more than 400 RPM.
- The ignition 1 signal is more than 8 volts.
- The above conditions are met for more than 1 second.
- DTC P0103 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is more than 12,000 Hz.

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

- Inspect the air induction system for any water intrusion. The water rapidly cools the hot sensing elements in the sensor causing a false indication of excessive air flow. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A poor connection in the ignition 1 voltage circuit of the MAF sensor may cause this DTC to set.
- If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

3. This step tests for electromagnetic interference (EMI) on the signal circuit of the MAF sensor. A frequency reading with the MAF sensor disconnected indicates an EMI related fault or a poor connection at the PCM. Disconnecting the MAF sensor may set additional related DTCs.
4. This step will determine if incorrect harness routing has caused this DTC to set.
5. This step will determine if water intrusion has caused this DTC to set.

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 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. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF)/intake air temperature (IAT) sensor. **IMPORTANT:** *Running the engine with the MAF/IAT sensor disconnected may set additional MAF and IAT DTCs.* 3. Start the engine. 4. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter more than the specified value?	0 Hz	Go to Step 4	Go to Step 5

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Inspect the harness of the MAF sensor for incorrect routing that is too close to the following components: – Any aftermarket accessories--Refer to Checking Aftermarket Accessories. – The secondary ignition wires or the coils – Any solenoids – Any relays – Any motors Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
5	1. Turn OFF the ignition. 2. Inspect the air induction system for any water intrusion. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	Test for an intermittent and for a poor connection at the MAF sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	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. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—

DTC P0103				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0106

DTC Descriptor

DTC P0106: Manifold Absolute Pressure (MAP) Sensor Performance

Diagnostic Fault Information

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

Typical Scan Tool Data

MAP Sensor

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during idle or deceleration. The PCM should detect a high signal voltage at high MAP, such as the ignition is ON, with the engine OFF, or at wide open throttle (WOT). The MAP sensor is also used to in order to determine the barometric pressure (BARO).

This occurs when the ignition switch is turn ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

The PCM calculates a predicted value for the MAP sensor based on the throttle position (TP) and the engine speed. The PCM then compares the predicted value to the actual MAP sensor signal. If the PCM detects that the MAP sensor signal is not within the predicted range, DTC P0106 sets.

Conditions for Running the DTC

- DTCs P0068, P0107, P0108, P0120, P0220, P0506, P0507, P2135 are not set.
- The engine is running.
- The engine speed is between 500-5,000 RPM.
- Any change in the engine speed is less than 125 RPM.
- The change in air flow is less than 10 g/s.
- The traction control, if equipped, is not active.
- The power take-off (PTO), if equipped, is not active.
- The A/C compressor clutch state does not change.
- The power steering load is stable.
- The brake switch state does not change.
- The above conditions are met for 1 second.
- DTC P0106 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor signal is not within the predicted range 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.

Circuit/System Verification

IMPORTANT:
Verify that the engine is in good mechanical condition before continuing with this diagnostic.

- Verify the integrity of the air induction system by inspecting for the following conditions:
  - Any damaged components
  - Loose or improper installation
  - Improperly routed vacuum hoses
  - Any vacuum leak
  - Any type of restriction
  - A MAP sensor seal that is missing or damaged
- Verify that restrictions do not exist in the MAP sensor vacuum source.
- Verify that restrictions do not exist in the exhaust system. Refer to Restricted Exhaust.
- A skewed or stuck engine coolant temperature (ECT) or IAT sensor will cause the calculated models to be inaccurate and may cause this DTC to run when it should not. Refer to Temperature Versus Resistance.
- The BARO that is used by the PCM to calculate the air flow models is initially based on the MAP sensor at ignition ON. When the engine is running, the PCM will continually update the BARO value near wide open throttle using the MAP sensor and a calculation. A skewed MAP sensor will cause the BARO value to be inaccurate. Use the scan tool and compare the BARO parameter at ignition ON to the Altitude vs. Barometric Pressure Table. Refer to Altitude Versus Barometric Pressure.

- A skewed MAP sensor will also cause the first and second intake manifold models to disagree with the actual MAP sensor measurements. Use the scan tool and compare the MAP Sensor parameter to a known good vehicle, under various operating conditions.
- Inspect for the following conditions:
  - Incorrect cam timing--Refer to Timing Chain and Sprockets Replacement.
  - Worn piston rings--Refer to Engine Compression Test.

Circuit/System Testing

Turn ON the ignition, with the engine OFF.

Disconnect the MAP sensor.

IMPORTANT

Certain resistances will not be detectable if a test lamp is not connected to provide a circuit load.

1. Connect a test lamp between the MAP sensor 5-volt reference circuit and a good ground.
2. Measure for a proper range of 4.8-5.2 volts between the MAP sensor 5-volt reference circuit and a good ground.
   - If the voltage is less than the specified range, then test the circuit for an open, or high resistance. If the circuit tests normal, replace the PCM.
   - If the voltage is more than the specified range, then test the circuit for a short to voltage. If the circuit tests normal, replace the PCM.
3. With the MAP sensor still disconnected, use the scan tool to observe the MAP Sensor parameter for the proper value of less than 12 kPa.
   - If the MAP Sensor parameter is more than 12 kPa, then test the MAP sensor signal circuit for a short to voltage. If the circuit tests normal, replace the PCM.
4. Connect a 3-amp jumper wire between the MAP sensor 5-volt reference circuit and the MAP sensor signal circuit.
5. Use the scan tool to observe the MAP Sensor parameter for the proper value of more than 103 kPa.
   - If the MAP Sensor parameter is less than 103 kPa, then test the MAP sensor signal circuit for high resistance. If the circuit tests normal, replace the PCM.
6. Turn OFF the ignition, and all electrical accessories. Allow sufficient time for the control module to power down before taking a resistance measurement.

7. Measure for a proper value of less than 10 ohms of resistance between the low reference circuit of the MAP sensor and a good ground.
   - If the resistance is more than 10 ohms, then test the circuit for high resistance. If the circuit tests normal, replace the PCM.
8. If the MAP sensor circuits test normal, then replace the MAP sensor.

DTC P0107

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively low, diagnostic trouble code (DTC) P0107 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0107 Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- DTC P0068, P0120, P0220, P2135 are not set.
- The engine is running.
- The throttle angle is more than 0 percent when the engine speed is less than 800 RPM. OR The throttle angle is more than 12.5 percent when the engine speed is more than 800 RPM.
- DTC P0107 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is less than 0.055 volt for more 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.

DTC P0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0641 also set?	—	Go to DTC P0641	Go to Step 3
3	Observe the Manifold Absolute Pressure (MAP) Sensor parameter with the scan tool. Is the voltage is 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. 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 Testing for Intermittent Conditions and Poor Connections
5	Test for an intermittent and for a poor connection at the MAP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 6

DTC P0107				
Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. **IMPORTANT:** *Certain resistances will not be detectable if a test lamp is not connected to provide a circuit load.* 4. Connect a test lamp between the MAP sensor 5-volt reference circuit and a good ground. 5. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground, with a DMM. Is the voltage more than the specified value?	4.8 V	Go to Step 7	Go to Step 8
7	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the MAP sensor and the signal circuit of the MAP sensor. 2. Observe the MAP Sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to Step 11	Go to Step 9
8	Test the 5-volt reference circuit between the powertrain control module (PCM) and the MAP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	Test the MAP sensor signal circuit between the PCM and the MAP sensor for a short to ground or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

DTC P0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
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. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0108

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively high, DTC P0108 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0108 Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Conditions for Running the DTC

- DTCs P0068, P0120, P0220, P2135 are not set.
- The engine has been running for a length of time that is determined by the startup coolant temperature. The length of time ranges from 10-242 seconds.
- The accelerator pedal angle is less than 1 percent when the engine speed is less than 1,200 RPM. OR The throttle angle is less than 20 percent when the engine speed is more than 1,200 RPM.
- DTC P0108 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is more than 4.9 volts for more 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.

DTC P0108				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check – Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Observe the Manifold Absolute Pressure (MAP) Sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to Step 4	Go to Step 3
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. Did the DTC fail this ignition?	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Inspect the MAP sensor vacuum source for the following conditions: • A leak • A restriction • A faulty connection Did you find and correct the condition?	—	Go to Step 15	Go to Step 5
5	Monitor the DTC Information with the scan tool. Is DTC P0641 also set?	—	Go to Step 9	Go to Step 6

DTC P0108				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP Sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to Step 8	Go to Step 10
8	1. Turn OFF the ignition. 2. Connect a jumper wire between each of the terminals in the MAP sensor harness connector and the corresponding terminal at the MAP sensor. Refer to Using Connector Test Adapters. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the low reference circuit of the MAP sensor at the jumper wire terminal to a good ground with the DMM. Refer to Measuring Voltage Drop. Is the voltage more than the specified value?	0.2 V	Go to Step 11	Go to Step 13
9	1, Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP Sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to DTC P0641	Go to Step 10
10	Test the MAP sensor signal circuit between the powertrain control module (PCM) and the MAP sensor for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

DTC P0108				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Test the low reference circuit between the PCM and the MAP sensor for an open or for high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
12	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0112

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively low IAT signal voltage, indicating a high temperature, DTC P0112 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0128, P0502, P0503 are not set.
- The engine run time is more than 45 seconds.
- The vehicle speed sensor (VSS) indicates that the vehicle speed is more than 40 km/h (25 mph).
- The engine coolant temperature (ECT) is less than 125°C (257°F).
- DTC P0112 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is more than 128°C (262°F) for 12.5 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

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to Temperature vs Resistance.
- If an intermittent condition is suspected, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0112				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	128°C (262°F)	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 Fame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Disconnect the IAT sensor. Observe the IAT Sensor parameter with a scan tool. Is the IAT Sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 6	Go to Step 5
5	Test the signal circuit of the IAT sensor for a short to ground or a short to the IAT low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	Replace the IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—

DTC P0112				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 8	—
8	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 9
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0113

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively high IAT signal voltage, indicating a low temperature, DTC P0113 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0128, P0502, P0503 are not set.
- The engine run time is more than 120 seconds.
- The vehicle speed sensor (VSS) indicates that the vehicle speed is less than 11 km/h (7 mph).
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The mass air flow (MAF) is less than 15 g/s.
- DTC P0113 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is less than -38°C (-36°F) for more than 12.5 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

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to Temperature vs Resistance.
- If a short to a separate 5-volt source occurs this DTC may set.
- If an intermittent condition is suspected, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

7. This step tests for the proper operation of the circuit in the low voltage range.

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Monitor the DTC information with the scan tool. Is DTC P0641 also set?	—	Go to DTC P0641	Go to Step 3
3	Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 5	Go to Step 4
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. Did the DTC fail this ignition?	—	Go to Step 5	Go to Diagnostic Aids
5	1. Disconnect the mass air flow (MAF)/IAT sensor. 2. Connect a DMM between the signal circuit of the IAT sensor and a good ground. Is the voltage more than the specified value?	5.2 V	Go to Step 6	Go to Step 7

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
7	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and the low reference circuit of the IAT sensor. Refer to Using Fused Jumper Wires. 2. Observe the IAT Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	128°C (262°F)	Go to Step 11	Go to Step 8
8	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and a good ground. Refer to Using Fused Jumper Wires. 2. Observe the IAT Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	128°C (262°F)	Go to Step 10	Go to Step 9
9	Test the signal circuit of the IAT sensor for an open circuit or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
10	Test the IAT sensor low reference circuit for high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
11	Test the IAT signal circuit for a short to any 5-volt reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test for an intermittent and for a poor connection at the IAT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	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. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the PCM. Refer to Control Module References for replacement, setup, and programming . 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. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 17

DTC P0113				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0116

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the signal circuit and a ground for the ECT low reference circuit. When the engine coolant temperature is low, the sensor resistance is high. When the engine coolant temperature is high, the sensor resistance is low. The PCM uses this High Side Coolant Rationality test to determine if the ECT input is skewed high. The internal clock of the PCM will record the amount of time the ignition is OFF. At restart the PCM will compare the temperature difference between the ECT and the intake air temperature (IAT). Before failing this test, the PCM will perform a calculation to determine the presence of an engine block heater. If the PCM detects that the temperature difference between the ECT and the IAT is not within the calibrated range after the ignition OFF time, DTC P0116 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0116 Engine Coolant Temperature (ECT) Sensor Performance

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0112, P0113, P0117, P0118, P0128, P0502, P0503 are not set.
- The IAT Sensor parameter is more than -7°C (20°F).
- The vehicle has a minimum ignition OFF time of 10 hours.
- DTC P0116 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The start-up ECT is more than the start-up IAT by 100°C (180°F).

OR

If the start-up ECT is more than the start-up IAT by 15°C (27°F), then the vehicle must be driven for more than 400 seconds over 24 km/h (15 mph). If the IAT sensor temperature decreases more than 8°C (14°F), a block heater is detected and the test is aborted. If the IAT sensor temperature does not decrease, a block heater was not detected and DTC P0116 sets.

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 P0116 may set if the vehicle uses an aftermarket engine block heater.

Test Description

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

7. A snapshot is the quickest method to capture the data before it changes.
8. An IAT sensor that is skewed low can cause this DTC to set.
10. This step will determine if high resistance has caused this DTC to set.
12. A high resistance short from the signal circuit to the low reference circuit can cause this DTC to set.

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Inspect the cooling system coolant level. Is the cooling system coolant low?	—	Service the Cooling System as Required	Go to Step 3
3	Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. Did you complete the action?	—	Go to Step 4	—
4	**IMPORTANT:** *The vehicle needs to have been OFF for at least 10 hours for the engine coolant temperature (ECT) and the intake air temperature (IAT) to be at ambient temperature. The vehicle should not have changed environments during this time.* Has the engine been OFF for the specified amount of time?	10 hrs	Go to Step 7	Go to Step 5
5	1. Remove the mass air flow (MAF)/IAT sensor. Refer to Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement. 2. Remove the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. 3. Place the sensors on a work surface away from any heat source. 4. Allow the sensors to reach the ambient air temperature for 30-60 minutes. Are the sensors at the ambient temperature?	—	Go to Step 6	—

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect the MAF/IAT sensor to the electrical connector, but DO NOT install it. 2. Insulate the sensor from any engine heat source. 3. Connect the ECT sensor to the electrical connector, but DO NOT install it. 4. Insulate the sensor from any engine heat source. Are the sensors connected?	—	Go to Step 7	—
7	**IMPORTANT:** *The IAT sensor will start to warm-up as soon as the ignition is turned ON.* 1. Turn ON the ignition. 2. Take a snapshot of the Engine Data List with a scan tool. 3. Review the snapshot data that was taken with the scan tool. 4. Observe the ECT Sensor parameter with a scan tool. 5. Observe the IAT Sensor parameter with a scan tool. Is the difference between the ECT Sensor parameter and the IAT Sensor parameter more than the specified value?	15°C (27°F)	Go to Step 8	Go to Testing for Intermittent Conditions and Poor Connections
8	Observe the recorded IAT Sensor parameter. Is the difference between the IAT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to Step 9	Go to Step 10
9	Observe the recorded ECT Sensor parameter. Is the difference between the ECT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 12

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Disconnect the MAF/IAT sensor. Test for an intermittent and for a poor connection at the IAT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 11
11	1. At the sensor, measure the resistance between the IAT signal and the IAT low reference terminals with a DMM and record the value. Refer to Circuit Testing. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the IAT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to Temperature vs Resistance. Is the resistance measurement of the IAT sensor within the specified range?	—	Go to Step 14	Go to Step 22
12	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: – An ECT sensor leaking engine coolant internally through the sensor – Corrosion on the ECT sensor terminals – Corrosion on the ECT harness connector terminals Did you find and correct the condition?	—	Go to Step 25	Go to Step 13

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	**IMPORTANT:** *Do not hold the ECT sensor by the probe.* 1. At the sensor, measure the resistance between the ECT signal and the ECT low reference terminals with a DMM and record the value. Refer to Circuit Testing. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the ECT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to Temperature vs Resistance. Is the resistance measurement of the ECT sensor within the specified range?	—	Go to Step 15	Go to Step 23
14	**IMPORTANT:** *All electrical components and accessories must be turned OFF. Performing this step will disable the diagnostic for 10 hours.* 1. Turn OFF the ignition for 90 seconds to allow the control modules to power down. 2. Measure the resistance from the low reference circuit of the IAT sensor to a good ground with a DMM. Refer to Circuit Testing. Is the resistance less than the specified value?	5 ohms	Go to Step 16	Go to Step 17
15	Measure the voltage from the ECT signal circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 19

DTC P0116				
Step	Action	Value(s)	Yes	No
16	1. Disconnect the powertrain control module (PCM). 2. Measure the resistance of the IAT sensor signal circuit between the sensor harness and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 18
17	Test the IAT low reference circuit for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20
18	Test the IAT signal circuit for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20
19	Test the ECT signal circuit for a high resistance short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 21
20	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
21	Test for shorted terminals and poor connections at the PCM. Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 25	Go to Step 24

DTC P0116				
Step	**Action**	**Value(s)**	**Yes**	**No**
22	Replace the MAF/IAT sensor. Refer to Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor Replacement. Did you complete the replacement? -	—	Go to Step 25	—
23	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
24	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 25	—
25	Reassemble the vehicle as necessary. Did you complete the action?	—	Go to Step 26	—
26	**IMPORTANT:** *This DTC will not run without the ignition being OFF for at least 10 hours.* 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 10 hours. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running in 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 27
27	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0117

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively low ECT signal voltage, which is a high temperature indication, DTC P0117 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine run time is more than 10 seconds. OR The engine run time is less than 10 seconds when the intake air temperature (IAT) is less than 50°C (122°F).
- DTC P0117 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects that the ECT Sensor parameter is more than 138°C (280°F) for more than 23 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 overheating condition may cause this DTC to set.
- If the condition is suspected of being an intermittent, refer to Testing for Intermittent Conditions and Poor Connections

DTC P0117				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter more than the specified value?	138°C (280°F)	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. Disconnect the ECT sensor. 2. Observe the ECT Sensor parameter with a scan tool. Is the ECT Sensor parameter less than the specified value?	-38°C (-36°F)	Go to Step 6	Go to Step 5
5	Test the signal circuit of the ECT sensor for a short to ground or a short to the ECT low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition? -	—	Go to Step 10	Go to Step 8
6	Test for an intermittent and for a poor connection at the ECT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7

DTC P0117				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
8	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. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0118

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The ECT sensor has a signal circuit and a low reference circuit. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively high ECT signal voltage, which is a low temperature indication, DTC P0118 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine has been running for more than 60 seconds. OR The engine run time is less than 60 seconds when the intake air temperature (IAT) is more than 0°C (32°F)
- DTC P0118 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects that the ECT Sensor parameter is less than -38°C (-36°F) for 23 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

- If a short to a separate 5-volt source occurs, this DTC may set.
- If the condition is suspected of being intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0118				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter less than the specified value?	-38°C (-36°F)	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. Disconnect the ECT sensor. 2. Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Is the voltage more than the specified value?	5.2 V	Go to Step 5	Go to Step 6
5	**IMPORTANT:** *If a short to voltage occurs, the ECT sensor may be damaged.* Test the ECT signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0118				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and the low reference circuit. Refer to Using Fused Jumper Wires. 2. Observe the ECT Sensor parameter with the scan tool. Is the ECT Sensor parameter more than the specified value?	138°C (280°F)	Go to Step 10	Go to Step 7
7	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and a good ground. 2. Observe the ECT Sensor parameter with a scan tool. Is the ECT Sensor parameter more than the specified value?	138°C (280°F)	Go to Step 9	Go to Step 8
8	Test the signal circuit of the ECT sensor for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	Test the low reference circuit of the ECT sensor for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	Test the ECT signal circuit for a short to any 5-volt reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	Test for an intermittent and for a poor connection at the ECT sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13

DTC P0118				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0120

Circuit Description

The throttle position (TP) sensor 1 is a potentiometer type sensor with 3 circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor is used to determine the throttle plate angle for various engine management systems. The control module provides the TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensor then provides the control module a signal voltage proportional to throttle plate movement. TP sensor 1 signal voltage is low at closed throttle and increases as the throttle opens. When the control module detects that the TP sensor 1 signal or TP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0120 Throttle Position (TP) Sensor 1 Circuit

Conditions for Running the DTC

- DTCs U0107 or P2108 are not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 1 signal voltage is less than 0.37 volt or more than 4.51 volts.
- The above condition is present for more 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 throttle actuator control (TAC) module connectors for signs of water intrusion. When this occurs, multiple DTCs could be set with no 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 stored information, Capture info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

33. 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 stored information, Capture Info.

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect jumper wires between the throttle position (TP) sensor 1 terminals of the throttle body harness connector and the corresponding TP sensor 1 terminals of the throttle body. 5. Turn ON the ignition, with the engine OFF. 6. Close the throttle blade by hand. 7. Observe the TP sensor 1 voltage with a scan tool. Is the TP sensor 1 voltage within the specified range?	0.37-0.71 V	Go to Step 5	Go to Step 3
3	1. Turn OFF the ignition. 2. Connect jumper wires between the TP sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body. 3. Turn ON the ignition, with the engine OFF. 4. Close the throttle blade by hand. 5. Observe the TP sensor 2 voltage with a scan tool. Is the TP sensor 2 voltage within the specified range?	0.28-0.81 V	Go to Step 9	Go to Step 4
4	Is DTC P1518 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 9

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Open the throttle blade to wide open throttle (WOT) by hand. 2. Observe the TP Sensor 1 Voltage parameter on the scan tool. Is the TP Sensor 1 Voltage parameter more than the specified value?	4.51 V	Go to Step 9	Go to Step 6
6	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 7
7	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to Connector Repairs and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 8
8	1. Continue to observe DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 27	Go to Diagnostic Aids

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 1 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to Step 14	Go to Step 10
10	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 1 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 11
11	Test the TP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 12
12	Test the TP sensor 1 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 13
13	1. Disconnect the other TAC module harness connector. 2. Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 28
14	Measure the voltage from the TP sensor 1, 5-volt reference circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.54-5.21 V	Go to Step 24	Go to Step 15

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Is the voltage more than the specified value?	—	Go to Step 16	Go to Step 18
16	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 1, 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	5.21 V	Go to Step 32	Go to Step 17
17	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 1, 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 22
18	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to Step 19	Go to Step 30
19	1. Disconnect the TAC module harness connector containing the TP sensor circuits. 2. Test the TP sensor 1, 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 32	Go to Step 20

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	Test the TP sensor 1, 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	—	Go to Step 32	Go to Step 21
21	Test the APP sensor 1, 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition	—	Go to Step 32	Go to Step 22
22	Test for a short between the TP sensor 1, 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 23
23	Test for a short between the APP sensor 1, 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 32	Go to Step 28
24	1. Connect a fused jumper between the TP sensor 1 low-reference circuit and the TP sensor 1 signal circuit. 2. Observe the TP Sensor 1 Voltage parameter with a scan tool. Is the TP Sensor 1 parameter near the specified value?	0 V	Go to Step 26	Go to Step 25
25	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 32	Go to Step 28

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
26	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 29
27	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 30
28	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 32	Go to Step 31
29	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 32	—
30	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 32	—
31	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 32	—

DTC P0120				
Step	**Action**	**Value(s)**	**Yes**	**No**
32	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 33
33	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0128

Circuit Description

An engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the powertrain control module (PCM) for engine control, and as an enabling criteria for some diagnostics.

The air flow coming into the engine is accumulated and used to determine if the vehicle has been driven within conditions that would allow the engine coolant to heat up normally to the thermostat regulating temperature. If the coolant temperature does not increase normally or does not reach the regulating temperature of the thermostat, diagnostics that use ECT as enabling criteria may not run when expected.

This DTC will only run once per ignition cycle within the enabling condition. If the PCM detects the calibrated amount of air flow and engine run time have been met and the ECT has not met the minimum thermostat regulating temperature, DTC P0128 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0128 Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0220, P0502, P0503, P2135 are not present.
- The start-up ECT is less than 74°C (165°F) when the intake air temperature (IAT) is more than 10°C (50°F).

OR

- The start-up ECT is less than 50°C (122°F) when the IAT is between -7 and +10°C (+19 and +50°F).
- The fuel ethanol is less than 87 percent.
- The IAT sensor parameter is between -7 and +55°C (+19 and +131°F).
- The engine run time is between 120-1,370 seconds.
- The vehicle speed is more than 8 km/h (5 mph) for more than 2.5 km (1.5 miles).
- The mass air flow (MAF) is between 20-75 g/s with the average more than 10 g/s.
- DTC P0128 runs one time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The PCM detects all of the following conditions:

- The calibrated amount of engine run time has been met.
- The calibrated amount of engine air flow has been met.
- The calibrated vehicle speed and distance have been met.
- The calibrated minimum ECT of 79°C (175°F) has not been met when the IAT is more than 10°C (50°F).

OR

- The calibrated minimum ECT of 55°C (131°F) has not been met when the IAT is between -7 and +10°C (+19 and +50°F).

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 P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *The cooling fans are commanded ON when certain engine coolant temperature (ECT) DTCs are set.* Is the cooling system coolant low?	—	Service the Cooling System as required	Go to Step 3
3	Test and verify the proper operation of the thermostat. Refer to Thermostat Diagnosis. Did you find and correct the condition?	—	Go to Step 14	Go to Step 4
4	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: • Corrosion on the ECT sensor terminals • Improper or corroded terminals at the ECT harness connector • Loose terminals in the ECT harness connector--Refer to Testing for Intermittent Conditions and Poor Connections. Did you find and correct the condition?	—	Go to Step 14	Go to Step 5
5	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. Did you find and correct the condition?	—	Go to Step 14	Go to Step 6

DTC P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Measure the resistance of the ECT sensor signal circuit between the sensor and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Step 7	Go to Step 10
7	Measure the resistance of the ECT sensor low reference circuit between the sensor and the PCM with a DMM. Refer to Circuit Testing. Is the resistance within the specified range?	0-10 ohms	Go to Step 8	Go to Step 11
8	1. Turn OFF the ignition. 2. Remove the ECT sensor. 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to Temperature Versus Resistance. Is the resistance measurement of the ECT sensor within the specified range?	—	Go to Step 9	Go to Step 12
9	Install the ECT sensor. Is the action complete?-	—	Go to Step 13	—

DTC P0128				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Repair the high resistance in the ECT sensor signal circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
11	Repair the high resistance in the ECT sensor low reference circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
12	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0131 or P0151

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0131 sets for HO2S bank 1 sensor 1, or DTC P0151 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0131 HO2S Circuit Low Voltage Bank 1 Sensor 1
- DTC P0151 HO2S Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is less than 200 mV for 165 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.
- The control module commands the Loop Status open.

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 the voltage is varying above and below the specified range, the condition is not present.

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P0131 or P0151				
Step	Action	Value(s)	Yes	No
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 7	Go to Step 8
6	Test the HO2S high signal circuit for a short to ground. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 9
7	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
8	Test the HO2S high signal circuit for an open or high resistance. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the HO2S high signal circuit for a short to the following circuits: • HO2S low signal circuit • HO2S heater low control circuit Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Test for shorted terminals and for poor connections at the HO2S. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 15	—

DTC P0131 or P0151				
Step	**Action**	**Value(s)**	**Yes**	**No**
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	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass?	—	Go to Step 17	Go to DTC P0420 or P0430
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 - Vehicle	System OK

DTC P0132 or P0152

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0132 sets for HO2S bank 1 sensor 1, or DTC P0152 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0132 HO2S High Voltage Bank 1 Sensor 1
- DTC P0152 HO2S High Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is more than 1050 mV for 48 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.
- The control module commands the Loop Status open.

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 the voltage is varying above and below the specified range, the condition is not present.

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**Yes**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter within the specified range?	400-500 mV	Go to Step 5	Go to Step 6

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**Yes**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 7	Go to Step 8
6	Test the HO2S high signal circuit for a short to the HO2S heater low control circuit. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
7	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 9	Go to Step 11
8	1. Test the HO2S high signal circuit for an open or high resistance. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0132 or P0152				
Step	Action	Value(s)	Yes	Yes
9	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 12
10	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**Yes**
12	1. The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* • A silicon contaminated HO2S • Any water intrusion into the HO2S connector • Engine oil contaminated with fuel • An evaporative emission (EVAP) canister purge condition • An incorrect fuel pressure--Refer to Fuel System Diagnosis. • Any rich fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. • An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. • An air intake restriction or collapsed air intake duct • Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**Yes**
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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

DTC P0132 or P0152				
Step	**Action**	**Value(s)**	**Yes**	**Yes**
18	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass?	—	Go to Step 19	Go to DTC P0420 or P0430
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 - Vehicle	System OK

DTC P0133 or P0153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from above 625 mV to below 250 mV or from below 250 mV to above 625 mV. If the PCM detects that the transition time is too long, DTC P0133 sets for HO2S bank 1 sensor 1 or DTC P0153 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0133 HO2S Slow Response Bank 1 Sensor 1
- DTC P0153 HO2S Slow Response Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 29-55 g/s.
- The Engine Speed parameter is between 1,000-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 1 second.

This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S rich-to-lean or lean-to-rich average response time is more than a calibrated value for 100 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 the voltage is varying above and below the specified value, the condition is not present.

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
6	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step 7
7	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P0133 or P0153				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* • A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant. Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 12	—

DTC P0133 or P0153				
Step	Action	Value(s)	Yes	No
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0134 or P0154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0134 sets for HO2S bank 1 sensor 1 or DTC P0154 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0134 HO2S Circuit Insufficient Activity Bank 1 Sensor 1
- DTC P0154 HO2S Circuit Insufficient Activity Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Engine Run Time parameter is more than 300 seconds.
- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is between 350-550 mV for 60 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.

The control module commands the Loop Status open.

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.

3. If the voltage is varying above and below the specified value, the condition is not present.

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *When the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to Step 3	Go to DTC P0135, P0141, P0155, or P0161
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	Go to Step 4	Go to Step 5

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	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 5	Go to Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 6
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	0.2 V	Go to Step 8	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 12	Go to Step 10
9	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 13	Go to Step 11
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 17	—

DTC P0134 or P0154				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0135, P0141, P0155, or P0161

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. This diagnostic will only run once per ignition cycle. If the PCM detects that the heater current is not within an expected range, the following DTCs will set:

- DTC P0135 for HO2S bank 1 sensor 1
- DTC P0141 for HO2S bank 1 sensor 2
- DTC P0155 for HO2S bank 2 sensor 1
- DTC P0161 for HO2S bank 2 sensor 2

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0135 HO2S Heater Performance Bank 1 Sensor 1
- DTC P0141 HO2S Heater Performance Bank 1 Sensor 2
- DTC P0155 HO2S Heater Performance Bank 2 Sensor 1
- DTC P0161 HO2S Heater Performance Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0053, P0054, P0059, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 50°C (122°F).
- The Ignition 1 Signal parameter is between 10-18 volts.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 120 seconds.
- The above conditions are met for 2 seconds.
- This diagnostic runs 1 time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S Heater current parameter is more than 3.125 amps or less than 0.25 amps.
- The above condition is met for 10 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.

9. With no fault present, the test lamp will blink once per second.

DTC P0135, P0141, P0155, or P0161				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Whenever the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to Step 3	Go to Step 6
3	Observe the Freeze Frame/Failure Records for this DTC. Did the DTC fail with an engine run time of less than 10 seconds?	—	Go to Step 4	Go to Step 5
4	1. Operate the vehicle within the conditions for running the Heater Resistance Test. 2. Start the engine. Did the DTC fail this ignition?	—	Go to Step 6	Go to Testing for Intermittent Conditions and Poor Connections

DTC P0135, P0141, P0155, or P0161				
Step	Action	Value(s)	Yes	No
5	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 Heater Current Test. 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 6	Go to Testing for Intermittent Conditions and Poor Connections
6	Inspect the O2A or O2B fuse. Is the O2A or O2B fuse open?	—	Go to Step 7	Go to Step 8
7	Test the ignition 1 voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 10
8	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 19

DTC P0135, P0141, P0155, or P0161				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	**IMPORTANT:** *The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.* 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	—	Go to Step 11	Go to Step 12
10	**IMPORTANT:** *Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.* Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to Circuit Testing. Is any sensor shorted to ground?	—	Go to Step 20	Go to Testing for Intermittent Conditions and Poor Connections
11	Measure the resistance of the following circuits with a DMM: • HO2S heater low control circuit • Ignition 1 voltage circuit Refer to Circuit Testing. Is the resistance of either circuit more than the specified value?	3 ohms	Go to Step 18	Go to Step 16
12	Is the test lamp on steady?	—	Go to Step 13	Go to Step 14

DTC P0135, P0141, P0155, or P0161				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Test the HO2S heater low control circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 17
14	Test the HO2S heater low control circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 15
15	Test the HO2S heater low control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 17
16	Test for shorted terminals and for poor connections at the HO2S. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
18	Repair the circuit with high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 22	—
19	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 22	—

DTC P0135, P0141, P0155, or P0161				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	Replace the affected HO2S. Refer to the appropriate procedure: • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1 • Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2 • Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2 Did you complete the replacement?	—	Go to Step 22	—
21	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 22	—
22	Were you sent to this diagnostic from DTC P0134 or P0154?	—	Go to Step 17 in DTC P0134 or P0154	Go to Step 23
23	Were you sent to this diagnostic from DTC P0140 or P0160?	—	Go to Step 17 in DTC P0140 or P0160	Go to Step 24
24	1. Replace the O2A or O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 25
25	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0137 or P0157

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0137 sets for HO2S bank 1 sensor 2 or DTC P0157 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0137 HO2S Circuit Low Voltage Bank 1 Sensor 2
- DTC P0157 HO2S Circuit Low Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.

- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is less than 80 mV for 200 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 the voltage does not change more that the specified value, the condition is present.

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from less than 300 mV to greater than 600 mV. If the voltage is not varying, refer to DTC P0132 or P0152.* 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 8
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 10	Go to Step 11
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
10	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 14

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 15	Go to Step 13
13	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
14	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P0137 or P0157				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
16	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P0137 or P0157				
Step	Action	Value(s)	Yes	No
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	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 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0138 or P0158

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started, the PCM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0138 sets for HO2S bank 1 sensor 2 or DTC P0158 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0138 HO2S Circuit High Voltage Bank 1 Sensor 2
- DTC P0158 HO2S Circuit High Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0169, P0178, P0179, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Alcohol content parameter is less than 90 percent.
- The Fuel Tank Level Remaining parameter is greater than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.
- The above conditions are met for 2 seconds.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is greater than 950 mV for 200 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 the voltage does not change more that the specified value, the condition is present.

DTC P0138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from less than 300 mV to greater than 600 mV. If the voltage is not varying, refer to DTC P0131 or P0151.* 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	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 Testing for Intermittent Conditions and Poor Connections

DTC P0138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1, Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 6	Go to Step 5
5	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 7	Go to Step 8
6	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
7	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 9	Go to Step 11
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 10
10	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
11	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition	—	Go to Step 17	Go to Step 14

DTC P0138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – Engine oil contaminated with fuel – An EVAP canister purge condition – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any rich fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – An air intake restriction or collapsed air intake duct Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15

DTC P0138 or P0158				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. 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 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0140 or P0160

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0140 sets for HO2S bank 1 sensor 2 or DTC P0160 sets for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0140 HO2S Circuit/Insufficient Activity Bank 1 Sensor 2
- DTC P0160 HO2S Circuit/Insufficient Activity Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0054, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0141, P0161, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Engine Run Time parameter is more than 300 seconds.
- The Loop Status is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- This diagnostic runs 1 time per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S voltage parameter is between 410-490 mV for 150 seconds.
- The TP Indicated Angle parameter changes more than 5 percent within 1 second, 6 times.

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.

3. If the voltage is varying above and below the specified value, the condition is not present.

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *When the heated oxygen sensor (HO2S) heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.* 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to Step 3	Go to DTC P0135
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to Step 4	Go to Step 5

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	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 5	Go to Testing for Intermittent Conditions and Poor Connections
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to Step 7	Go to Step 6
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing Is the voltage more than the specified value?	0.2 V	Go to Step 8	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2 V	Go to Step 12	Go to Step 10
9	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 13	Go to Step 11
11	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Circuit Testing • Wiring Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Heated Oxygen Sensor (HO2S) Wiring Repairs • Testing for Intermittent Conditions and Poor Connections • Connector Repairs Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the affected HO2S. 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 17	—

DTC P0140 or P0160				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0171 or P0174

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 input. During Closed Loop, the PCM adds oxygen sensor inputs and level of purge to calculate short and long term fuel trim adjustments. If the oxygen sensors indicate a lean condition, fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, fuel trim values will be below 0 percent. The values for the short term fuel trim change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. Long term fuel trim makes course adjustments in order to maintain an air/fuel ratio of 14.7:1. A block of cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term fuel trim diagnostic is based on an average of cells currently being used. The PCM selects the cells based on the engine speed and engine load. If the PCM detects an excessively lean condition, DTC P0171 or P0174 sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0171 Fuel Trim System Lean Bank 1
- DTC P0174 Fuel Trim System Lean Bank 2

Conditions for Running the DTC

- DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0101, P0102, P0103, P0106, P0107, P0108, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0300, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0506, P0507, P1133, P1134, P1153, P1154, P2A01, P2A04 are not set.
- The Fuel Trim Learn parameter is enabled.
- The Loop Status parameter is closed.
- The engine coolant temperature (ECT) is between -40 to +139°C (-40 to +282°F).
- The intake air temperature (IAT) is between -20 to +152°C (-4 to +304°F).
- The manifold absolute pressure (MAP) is between 15-105 kPa (2.2-15.2 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 400-6,500 RPM.
- The barometric pressure (BARO) is more than 70 kPa (10.2 psi).
- The mass air flow (MAF) is between 1-250 g/s.
- The fuel level is more than 15 percent.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The long term fuel trim value is more than a calibrated value for approximately 3 minutes after the Conditions for Running the DTC have been met.

Action Taken When the DTC Sets

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 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. The control module illuminates the malfunction indicator lamp (MIL) when one of the following occur:

- The control module detects the same fuel trim failure during 2 consecutive trips.
- The control module detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
  - The engine load is within 20 percent of the previous test that failed.
  - The engine speed is within 375 RPM of the previous test that failed.
  - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 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 and related Freeze Frame data clears after 40 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 resistance in the fuel injector control and/or the ignition 1 voltage circuits may cause the following symptoms:
  - A lean condition
  - Misfire
  - Rough idle Refer to DTC P0200.
- The system may become lean if an injector is not suppling enough fuel.
- A lean condition could be present during high fuel demand.
- Review the Failure Records with a scan tool. If an intermittent condition is suspected, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0171 or P0174				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Are any DTCs other than DTC P0171 or P0174 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Install the scan tool. 2. Start and idle the engine at the normal operating temperature in Closed Loop. 3. Record the long term fuel trim. 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 greater than the specified value?	24%	Go to Step 4	Go to Diagnostic Aids
4	1. Operate the engine at idle. 2. Observe the HO2S parameters with a scan tool. 3. Does the scan tool indicate that the parameter is within the specified range and fluctuating?	200-800 mV	Go to Step 5	Go to Step 6

DTC P0171 or P0174				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the engine. 2. Visually and physically inspect the following items: – The vacuum hoses for splits, kinks, and proper connections – Ensure that the vehicle has sufficient fuel in the tank. If the fuel pressure is too low, this DTC may set. Refer to Fuel System Diagnosis. – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Any lean fuel injectors--Refer to Fuel Injector Balance Test with Tech 2. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	1, Turn OFF the engine. 2. Inspect the heated oxygen sensor (HO2S) for proper installation. 3. Verify the electrical connectors and the wires are secure, and not contacting the exhaust system. 4. Test for continuity between the HO2S signal circuit and the low reference circuit. Refer to the following procedures: – Circuit Testing – Wiring Repairs – Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 8	Go to Fuel System Diagnosis

DTC P0171 or P0174

Step	Action	Value(s)	Yes	No
7	1. Operate the engine at idle. 2. Inspect for any missing, loose, or leaking exhaust components forward of the HO2S. 3. Inspect for vacuum leaks at the intake manifold, throttle body, and injector O-rings. 4. Inspect the air induction system and the air intake ducts for leaks. 5. Inspect the secondary air injection (AIR) system for leaks, improper air delivery, and for the shut-off valves not closing. 6. Inspect the crankcase ventilation system for leaks. Refer to Crankcase Ventilation System Inspection/Diagnosis. 7. Inspect the EVAP lines and components for damage or blockage. 8. Inspect the vacuum brake booster for leaks. Did you find and correct the condition?	—	Go to Step 8	Go to Symptoms - Engine Mechanical
8	**IMPORTANT:** *After repairs, use the scan tool Fuel Trim Reset function to reset the Long Term Fuel Trim.* 1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9

DTC P0171 or P0174				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass	—	Go to Step 10	Go to DTC P0420 or P0430
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 - Vehicle	System OK

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 input. During Closed Loop, the PCM adds oxygen sensor inputs and level of purge to calculate short and long term fuel trim adjustments. If the oxygen sensors indicated a lean condition, fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, fuel trim values will be below 0 percent. The values for the short term fuel trim 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. A block of cells contain information arranged in combinations of engine RPM and engine load for a fuel range of vehicle operating conditions. The long term fuel trim diagnostic is based on an average of cells currently being used. The PCM selects the cells based on the engine speed and engine load. 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.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0172 Fuel Trim System Rich Bank 1
- DTC P0175 Fuel Trim System Rich Bank 2

Conditions for Running the DTC

- DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0101, P0102, P0103, P0106, P0107, P0108, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0300, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0506, P0507, P1133, P1134, P1153, P1154, P2A01, P2A04 are not set.
- The Fuel Trim Learn parameter is enabled.
- The Loop Status parameter is closed.
- The engine coolant temperature (ECT) is between -40 to +139°C (-40 to +282° F).
- The intake air temperature (IAT) is between -20 to +152°C (-4 to +304°F).
- The manifold absolute pressure (MAP) is between 15-105 kPa (2.2-15.2 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 400-6,500 RPM.
- The barometric pressure (BARO) is more than 70 kPa (10.2 psi).
- The mass air flow (MAF) is between 1-250 g/s.
- The fuel level is more than 15 percent.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The long term fuel trim value is more than a calibrated value for approximately 3 minutes after the Conditions for Running the DTC have been met.

Action Taken When the DTC Sets

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 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. The control module illuminates the malfunction indicator lamp (MIL) when one of the following occur:

- The control module detects the same fuel trim failure during 2 consecutive trips.
- The control module detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
  - The engine load is within 20 percent of the previous test that failed.
  - The engine speed is within 375 RPM of the previous test that failed.
  - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 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 and related Freeze Frame data clears after 40 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 MAF sensor can cause a rich condition and set this DTC. Refer to DTC P0101.
- Review Failure Records with a scan tool. If an intermittent condition is suspected , refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

7. An EVAP canister that is saturated will cause a rich condition.

DTC P0172 or P0175				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Are any DTCs other than DTC P0172 or P0175 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Install a scan tool. 2. Start and idle the engine at the normal operating temperature in Closed Loop. 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 4	Go to Diagnostic Aids
4	1. Operate engine at idle. 2. Observe Heated Oxygen Sensor (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 5	Go to Step 6

DTC P0172 or P0175				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the engine. 2. Visually and physically inspect the following items: – The evaporative emission (EVAP) lines and components for damage or blockage. – The inlet screen of the mass air flow (MAF) sensor for blockage – The vacuum hoses for splits, kinks, and proper connections. – The air intake duct for being collapsed or restricted – The air filter for being dirty or restricted – For objects blocking the throttle body Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	1. Turn OFF the 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 the following: – Circuit Testing – Wiring Repairs – Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 8	Go to Fuel System Diagnosis

DTC P0172 or P0175				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	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 8	Go to Symptoms - Engine Mechanical
8	**IMPORTANT:** *After repairs, use the scan tool Fuel Trim Reset function to reset the Long Term Fuel Trim.* 1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	In order to ensure that the performance of the catalyst has not been affected by the fault that set this DTC, operate the vehicle within the conditions for running and setting DTC P0420 or P0430 and verify that P0420 or P0430 runs and passes. Refer to DTC P0420 or P0430. Does the DTC run and pass	—	Go to Step 10	Go to DTC P0420 or P0430
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 - Vehicle	System OK

DTC P0200

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0200 Injector Control Circuit

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 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 isolate an intermittent condition. Refer to Fuel Injector Solenoid Coil Test
- For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. This step tests for voltage at the fuel injector harness connector. The INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply circuit is indicated.
5. This step verifies that the PCM is able to control the fuel injector. If the test lamp blinks, then the PCM and wiring are OK.
6. This step tests if a ground is constantly being applied to the fuel injector.

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 as specified in the supporting text or as close to the Freeze Frame/Failure Records that you observed. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the harness connector of the fuel injector for the cylinder which indicated misfire. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition voltage circuit of the fuel injector with a test lamp 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 TBI Harness Test Lamp between the control circuit and the ignition 1 voltage circuit of the fuel injector harness connector. 2. Start the engine. Does the test lamp blink?	—	Go to Step 9	Go to Step 6
6	Does the test lamp remain illuminated at all times?	—	Go to Step 8	Go to Step 7

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Test the control circuit of the fuel injector for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
8	Test the control circuit of the fuel injector for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
9	Inspect for poor connections at the harness connector of the fuel injector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
11	**IMPORTANT:** *The INJ fuses also supply voltage to the ignition coil modules. If a fuse is open, inspect all related circuits for a short to ground.* **1.** Repair the open or short to ground in the ignition voltage circuit of the fuel injector. Refer to Wiring Repairs. 2. Replace the fuse, if necessary. Did you complete the repair?	—	Go to Step 14	—
12	Replace the fuel injector. Refer to Fuel Injector Replacement. Did you complete the replacement?	—	Go to Step 14	—

DTC P0200				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. Does the DTC run and pass?	—	Go to Step 15	Go to Step 2
15	Observe the Capture Info with a scan tool. Does the scan tool display any DTCs that you have not diagnosed	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0220

Circuit Description

The throttle position (TP) sensor 2 is a potentiometer type sensor with 3 circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor is used to determine the throttle plate angle for various engine management systems. The control module provides the TP sensor with a 5-volt reference circuit and a low reference circuit. The TP sensor then provides the control module with a signal voltage proportional to throttle plate movement. TP sensor 1 signal voltage is low at closed throttle and increases as the throttle opens. When the control module detects that the TP sensor 2 signal or TP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0220 Throttle Position (TP) Sensor 2 Circuit

Conditions for Running the DTC

- DTCs U0107 or P2108 are not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 2 voltage is less than 0.28 volt or greater than 4.60 volts.
- The above condition is present for more 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 throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

31. 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 stored information.

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect jumper wires between the throttle position (TP) sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body. 5. Turn ON the ignition, with the engine OFF. 6. Close the throttle blade by hand. 7. Observe the TP sensor 2 voltage with a scan tool. Is the TP sensor 2 voltage within the specified range?	0.28-0.81 V	Go to Step 3	Go to Step 7
3	1. Open the throttle blade to wide open throttle (WOT) by hand. 2. Observe the TP Sensor 2 Voltage parameter on the scan tool. Is the TP Sensor 2 Voltage parameter more than the specified value?	4.60 V	Go to Step 7	Go to Step 4
4	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 5

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to Connector Repairs and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 6
6	1. Continue to observe DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 25	Go to Diagnostic Aids
7	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 2 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to Step 12	Go to Step 8
8	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 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 9

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the TP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 10
10	Test the TP sensor 2 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 11
11	1. Disconnect the other TAC module harness connector. 2. 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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
12	Measure the voltage from the TP sensor 2, 5-volt reference circuit to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.54-5.21 V	Go to Step 22	Go to Step 13
13	Is the voltage more than the specified value?	5.21 V	Go to Step 14	Go to Step 16
14	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 15

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 2, 5-volt reference circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 20
16	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to Step 17	Go to Step 28
17	Disconnect the TAC module harness connector containing the TP sensor circuits. Test the TP sensor 2, 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 30	Go to Step 18
18	Test the TP sensor 2, 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	—	Go to Step 30	Go to Step 19
19	Test the APP sensor 2, 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 20

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 21
21	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. Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
22	1. Connect a fused jumper between the TP sensor 2 low-reference circuit and the TP sensor 2 signal circuit. 2. Observe the TP Sensor 2 Voltage parameter with a scan tool. Is the TP Sensor 2 parameter near the specified value?	0 V	Go to Step 24	Go to Step 23
23	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 2 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 30	Go to Step 26
24	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 27

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
25	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 28
26	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
27	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 30	—
28	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 30	—
29	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 30	—
30	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 31

DTC P0220				
Step	**Action**	**Value(s)**	**Yes**	**No**
31	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0230

Circuit Description

The powertrain control module (PCM) provides ignition positive voltage to the coil side of the fuel pump relay. When the ignition switch is first turned ON, the PCM energizes the fuel pump relay, which applies power to the fuel pump. The PCM enables the fuel pump relay as long as the engine is cranking or running, and crankshaft reference pulses are received. If no crankshaft reference pulses are received, the PCM de-energizes the fuel pump relay after 2 seconds. The PCM monitors the voltage on the fuel pump relay control circuit. If the PCM detects an incorrect voltage on the fuel pump relay control circuit, DTC P0230 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0230 Fuel Pump Relay Control Circuit

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 PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- All 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.

Test Description

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

2. Listen for a click when the fuel pump relay operates. Command both the ON and OFF states. Repeat the commands as necessary.
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 voltage is constantly being applied to the control circuit of the fuel pump relay.

DTC P0230				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF with each command?	—	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 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 4	Go to Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp connected to a good ground. 5. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	—	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 relay. 2. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 11
6	Does the test lamp remain illuminated with each command?	—	Go to Step 8	Go to Step 7

DTC P0230				
Step	**Action**	**Value(s)**	**Yes**	**No**
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. 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. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
9	Inspect for poor connections at the fuel pump relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connectors of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
11	Repair the ground circuit of the relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
12	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—

DTC P0230				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 as specified in the supporting text. Does the DTC run and pass?	—	Go to Step 15	Go to Step 2
15	Observe the stored information, Capture Info with a scan tool. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0300 Engine Misfire Detected

Conditions for Running the DTC

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0125, P0128, P0220, P0315, P0335, P0336, P0341, P0342, P0343, P0721, P0722, P1114, P1115, P1120, P1258 are not set.
- The engine speed is between 450-5,000 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 (TCS) 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.
- This diagnostic runs continuously when the above conditions are met.

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.
  - Worn or damaged accessory drive belt--Refer to Symptoms - Engine Mechanical 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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Misfire current counters incrementing?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	Go to Step 4
4	Can any abnormal engine noise be heard?	—	Go to Symptoms - Engine Mechanical	Go to Step 5
5	Does the scan tool indicate that the Heated Oxygen Sensor (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

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Inspect the following components: • The vacuum hoses and seals for splits, restrictions, and improper connections. • 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 powertrain control module (PCM) grounds for corrosion and loose 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. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
8	**IMPORTANT:** *An erratic or inconsistent spark is considered a no spark.* 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 a suitable Spark Tester. 4. Start the engine. Does the spark jump the tester gap?	—	Go to Step 10	Go to Step 9

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Remove the spark plug wire for the affected cylinders. 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 ohms	Go to Electronic Ignition (EI) System Diagnosis	Go to Step 19
10	1. Remove the spark plugs from the cylinders that indicated a misfire. Refer to Spark Plug Replacement. 2. Inspect the spark plugs. 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	Is the spark plug oil or coolant fouled?	—	Go to Symptoms - Engine Mechanical	Go to Step 13
13	Is the spark plug gas fouled?	—	Go to Step 16	Go to Step 14
14	Did the spark plug show any signs of being cracked, worn, or improperly gapped?	—	Go to Step 17	Go to Step 15

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 Symptoms - Engine Mechanical
16	Perform the fuel system diagnosis. Refer to Fuel System Diagnosis Did you find and correct the condition?	—	Go to Step 20	Go to Symptoms - Engine Mechanical
17	Replace or gap the spark plug. Refer to Spark Plug Replacement. Did you complete the action?	—	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 wires. Refer to Spark Plug Wire Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	Was the customer concern the malfunction indicator lamp (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

DTC P0300				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle in Vehicle DTC Information	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 sensors. 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 CKP System variation compensating values are stored in PCM memory after a learn procedure has been performed. If the actual CKP variation is not within the CKP System variation compensating values stored in the PCM, DTC P0300 may set.

If the CKP System variation values are not stored in the PCM memory, DTC P0315 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0315 Crankshaft Position (CKP) System Variation Not Learned

Conditions for Running the DTC

- DTCs P0335, P0336, P0341, P0342, P0343 are not set.
- The engine coolant temperature (ECT) is more than 70°C (158°F).
- This diagnostic runs continuously when the above conditions are met.

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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Perform the Crankshaft Position (CKP) 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	Inspect for the following conditions: • Worn crankshaft main bearings • Debris between the CKP sensor and the reluctor wheel • A damaged reluctor wheel • Excessive crankshaft runout • A damaged crankshaft--Refer to Crankshaft and Bearings Cleaning and Inspection in Engine Mechanical - 8.1L. • Electromagnetic interference (EMI) in the signal circuit of the CKP sensor • The ignition switch is in the ON position until the battery has insufficient system voltage. • A powertrain control module (PCM) power disconnect with the ignition ON that may have erased 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 for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 5

DTC P0315				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle in Vehicle DTC Information	System OK

DTC P0325

Circuit Description

The knock sensors (KS) produce an AC signal when specific frequencies are detected. When the engine operates, the powertrain control module (PCM) learns a minimum and maximum frequency of noise of normal engine operation. The KS System monitors both KS in order to determine if knock is present. If the KS System determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS System. The PCM then retards timing until no knock is present.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0325 Knock Sensor (KS) Circuit

Conditions for Running the DTC

- The engine is running.
- The engine run time more than 10 seconds.
- The ignition 1 signal is more than 10 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

A malfunction with the KS System or the circuits within the PCM are faulty for 15 seconds or more.

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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If you can hear the engine knock, repair the engine 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 Testing for Intermittent Conditions and Poor Connections
3	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. 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 DTC run and pass?	—	Go to Step 5	Go to Step 2

DTC P0325				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0327 or P0332

Circuit Description

The knock sensors (KS) produce an AC signal when specific frequencies are detected. When the engine operates, the powertrain control module (PCM) learns a minimum and maximum frequency of noise of normal engine operation. The KS System monitors both knock sensors in order to determine if knock is present. If the KS System determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS system. The PCM then retards the timing until no knock is present. When the PCM detects a frequency that is less than or more than a defined range, DTC P0327 will set for a failure in KS 1 which is located on bank 1 on the drivers side of the engine or DTC P0332 will set for a failure in KS 2 which is located on bank 2 on the passenger side of the engine.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0327 Knock Sensor (KS) 1 Circuit Low Frequency
- DTC P0332 Knock Sensor (KS) 2 Circuit Low Frequency

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0116, P0117, P0118, P0125, P1114, or P1115 are not set.
- The engine speed is between 1,600-3,000 RPM.
- The manifold absolute pressure (MAP) is less than 45 kPa.
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The engine run time is more than 20 seconds.
- The ignition more than 10 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM determines that this frequency is less than or more than the expected amount for 3 seconds or more.

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.

Diagnostic Aids

Inspect the KS for proper installation. A KS that is loose or over torqued may cause either DTC to set.

For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. This step verifies the malfunction is present.
3. This test will isolate the KS from the rest of the circuit.
4. Tapping on the engine block near the appropriate KS will simulate an engine knock.

DTC P0327 or P0332				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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. 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. Turn the ignition OFF. 2. Disconnect the knock sensor (KS) harness of the appropriate KS. 3. Set the DMM to the 400 K ohm scale. 4. Measure the resistance of the appropriate KS with a DMM connected to battery ground. Is the resistance of the KS within the specified range?	93-107K ohms	Go to Step 4	Go to Step 6

DTC P0327 or P0332				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Set the DMM to the 400 mv AC hertz scale. Refer to Measuring Frequency. **IMPORTANT:** *Do not tap on plastic engine components.* 2. Tap on the engine block near the appropriate KS while observing the signal indicated on the DMM. Is any signal indicated on the DMM while tapping on the engine block near the knock sensor?	—	Go to Step 5	Go to Step 6
5	1. Disconnect the powertrain control module (PCM) connector. Refer to Powertrain Control Module (PCM) Replacement. 2. Test the KS signal circuit between the PCM and the KS connector for the following: – An open – A short to voltage – A short to ground Refer to Circuit Testing in Wiring Systems. Did you find and correct the condition?	—	Go to Step 9	Go to Step 7
6	Replace the KS. Refer to Knock Sensor (KS) 1 Replacement or Knock Sensor (KS) 2 Replacement. Did you complete the replacement?	—	Go to Step 9	—
7	1. Inspect the KS signal circuit for a poor connection at the PCM or the KS harness connector. Refer to Testing for Intermittent Conditions and Poor Connections. 2. If you find a poor connection, repair the connector as necessary. Refer to Connector Repairs. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8

DTC P0327 or P0332				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	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 as specified in the supporting text. Does the DTC run and pass?	—	Go to Step 10	Go to Step 2
10	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 - Vehicle	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 more than 3 seconds, DTC P0335 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0335 Crankshaft Position (CKP) Sensor Circuit

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0341, P0342, or P0343 are not set.
- The camshaft position (CMP) sensor is transitioning.
- The mass air flow (MAF) is more than 3 g/s in the crank mode.
- The MAF is more than 5 g/s in the running mode.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects no signal from the CKP sensor for more than 3 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 determines if the fault is present.
6. This step simulates a CKP sensor signal to the PCM. If the PCM receives the signal, the fuel pump will operate for about two seconds.

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 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 Testing for Intermittent Conditions and Poor Connections

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	**CAUTION:** ***Before proceeding, remove the fuses for the ignition coil and fuel injector feed circuits in order to prevent personal injury from engine rotation, sparks, and excessive engine fueling.*** **IMPORTANT:** *An internally shorted CAM sensor can cause DTC P0335 to set. Test this circuit for a short before proceeding with this diagnostic table. Refer to Circuit Testing and Wiring Repairs.* 1. Turn ON the ignition, with the engine OFF. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Measure the voltage from the CKP sensor 12-volt reference circuit to a good ground with the DMM. Does the DMM display the specified value?	B+	Go to Step 5	Go to Step 7
5	Measure the voltage between the CKP sensor 12-volt reference circuit and the CKP sensor low reference circuit with the DMM. Does the DMM display the specified value?	B+	Go to Step 6	Go to Step 8
6	Momentarily connect the test lamp between the CKP sensor signal circuit and the CKP sensor 12-volt reference circuit. Does the fuel pump operate when voltage was applied to the CKP sensor signal circuit?	—	Go to Step 11	Go to Step 9

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Test for an open or a short to ground in the CKP sensor 12-volt reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
8	Test for an open or for high resistance in the CKP sensor low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
9	Test the CKP sensor signal circuit for the following conditions: • High resistance • An open • A short to ground or low reference • A short to voltage or 12-volt reference Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	—	Go to Step 16	Go to Step 10
10	Inspect for poor connections at the CKP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Remove the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. Visually inspect the CKP sensor for the following conditions: – Excessive play or looseness – Excessive air gap between the CKP sensor and the reluctor wheel – Physical damage – Foreign material passing between the CKP sensor and the reluctor wheel – Improper installation – Electromagnetic interference in the CKP sensor circuits Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12
12	Inspect the CKP reluctor wheel for the following conditions: • Physical damage • Improper installation • Excessive endplay or looseness Refer to Crankshaft and Bearings Cleaning and Inspection. Did you find and correct the condition?	—	Go to Step 16	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	Inspect for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you complete the repair?	—	Go to Step 16	Go to Step 15

DTC P0335				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. Did the DTC run and pass?	—	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 - Vehicle	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 signal is incorrect for more than 120 seconds, DTC P0336 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0336 Crankshaft Position (CKP) Sensor Circuit

Conditions for Running the DTC

- The engine is cranking or running.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM determines that the CKP sensor signal is out of range for more than 120 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 verifies that the malfunction is present.
3. This step tests for electromagnetic interference (EMI) on the CKP sensor circuits.

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTC P0335 is also set, diagnose DTC P0335 before proceeding with this DTC.* 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 Testing for Intermittent Conditions and Poor Connections
3	Inspect all of the crankshaft position sensor (CKP) circuits for the following conditions: • Wiring routed too closely to secondary ignition wires or components • Wiring routed too closely to after-market add-on electrical equipment • Wiring routed to closely to solenoids, relays, and motors • Electromagnetic interference in the CKP sensor circuits Did you find and correct the condition?	—	Go to Step 12	Go to Step 4
4	Test the 12-volt reference circuit for an intermittent condition or shorted to other circuits. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. Did you find and correct the condition?	—	Go to Step 12	Go to Step 5

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the low reference circuit for an intermittent condition. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. Did you find and correct the condition?	—	Go to Step 12	Go to Step 6
6	Test the CKP sensor signal circuit for an intermittent condition. Refer to Testing for Electrical Intermittents and Inducing Intermittent Fault Conditions. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test for an intermittent and for a poor connection at the CKP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	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 Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Remove the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. 2. Inspect the CKP sensor for the following conditions: – Physical damage – Improper installation – Excessive play or looseness – Excessive air gap between the CKP sensor and the reluctor wheel – Foreign material passing between the CKP sensor and the reluctor wheel – Insufficient fuel Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
10	Inspect the reluctor wheel for the following conditions: • Physical damage • Improper installation • Excessive endplay or looseness Refer to Crankshaft and Bearings Installation. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
11	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—

DTC P0336				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0341 Camshaft Position (CMP) Sensor Performance

Conditions for Running the DTC

- The engine is running and the engine speed is less than 4,000 RPM.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM detects that a CMP to CKP mismatch 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 Testing for Intermittent Conditions and Poor Connections.

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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 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 camshaft position (CMP) sensor for the following: – 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. Did you find and correct the condition?	—		Go to Step 5

DTC P0341				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	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. 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 Crankshaft and Bearings Cleaning and Inspection. 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	—

DTC P0341				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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 signal is constantly low, DTC P0342 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0342 Camshaft Position (CMP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.
- This diagnostic runs continuously when the above conditions are met.

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 Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP Sensor High to Low and Low to High parameter to increase if the circuit and the PCM are operating properly.

DTC P0342				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. 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. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 6

DTC P0342				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Start the engine. 2. Observe the CMP Sensor High to Low and Low to High Transition parameters with the scan tool. 3. Momentarily and repeatedly probe the signal circuit of the CMP sensor with a test lamp that is connected to battery voltage. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	—	Go to Step 8	Go to Step 7
6	Test the 12-volt reference circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. 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 a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
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. 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 powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P0342				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 – Wiring routed too close to the secondary ignition components Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
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 Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0343

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 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 crankshaft position (CKP) sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X 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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0343 Camshaft Position (CMP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.
- This diagnostic runs continuously when the above conditions are met.

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 Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP Sensor High to Low and Low to High parameter to increase if the circuit and the PCM are operating properly.

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. Probe the signal circuit of the CMP sensor with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5

DTC P0343				
Step	Action	Value(s)	Yes	No
5	1. Start the engine. 2. Observe the CMP Sensor High to Low and Low to High Transition parameters with the scan tool. 3. Momentarily and repeatedly probe the signal circuit of the CMP sensor with a test lamp that is connected to battery voltage. 4. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	—	Go to Step 6	Go to Step 10
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 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. 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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
8	Test the low reference circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. 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. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	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. 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 – Wiring routed too close to the secondary ignition components 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 Crankshaft and Bearings Cleaning and Inspection. 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 Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 15	—

DTC P0343				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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 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.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0351 Ignition Coil 1 Control Circuit
- DTC P0352 Ignition Coil 2 Control Circuit
- DTC P0353 Ignition Coil 3 Control Circuit
- DTC P0354 Ignition Coil 4 Control Circuit
- DTC P0355 Ignition Coil 5 Control Circuit
- DTC P0356 Ignition Coil 6 Control Circuit
- DTC P0357 Ignition Coil 7 Control Circuit
- DTC P0358 Ignition Coil 8 Control Circuit

Conditions for Running the DTC

- The engine is operating.
- This diagnostic runs continuously when the above conditions are met.

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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 Testing for Intermittent Conditions and Poor Connections
3	1. Turn OFF the engine. 2. Disconnect the respective ignition coil. 3. Start the engine. 4. Measure the frequency at the ignition control (IC) circuit with the DMM set to DC Hertz. Refer to Measuring Frequency. 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
5	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM) connector. 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

DTC P0351-P0358				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the respective IC circuit for a short to ground. Refer to Testing for Short to Ground. 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. 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. 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. 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. 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. 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. Did you complete the repair?	—	Go to Step 17	—

DTC P0351-P0358				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Repair the IC circuit for a short to voltage. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 17	—
14	Repair open in the IC circuit. Refer to Wiring Repairs. 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 Control Module References for replacement, setup, and programming. 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 - Vehicle	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 the PCM uses to indicate the oxygen storage capacity of the catalyst. This determines the catalysts ability to effectively convert the exhaust emissions.

If the catalyst is functioning correctly, the HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 signals will be far less active than the signals that are produced by HO2S bank 1 sensor 1 and 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 from 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.

IMPORTANT:
A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.

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.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0420 Catalyst System Low Efficiency Bank 1
- DTC P0430 Catalyst System Low Efficiency Bank 2

Conditions for Running the DTC

- DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0325, P0327, P0332, P0335, P0336, P0341, P0342, P0343, P0351-P0358, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0500, P0502, P0503, P0506, P0507, P1125, P1133, P1134, P1153, P1154, P1516, P2101, P2108, P2120, P2121, P2125, P2135, P2A01, P2A04, U0107 are not set.
- The engine has been running for more than 5 minutes.
- The intake air temperature (IAT) is between -20 to +85°C (-4 and +185°F).
- The barometric pressure (BARO) is more than 70 kPa.
- The engine coolant temperature (ECT) is more than 70-125°C (158-257°F).
- Since the end of the last idle period, the engine speed has been more than 950 RPM for 35 seconds.
- The engine must be at a stable idle speed, within 200 RPM of desired idle.
- The battery voltage is more than 11 volts.
- The Closed Loop fuel control is enabled.
- This diagnostic attempts one test during each valid idle period once the above conditions have been met. This diagnostic attempts up to 12 tests during each drive cycle.

Conditions for Setting the DTC

- The PCM determines that the oxygen storage capability of the TWC has degraded to less than a calibrated threshold.
- This diagnostic may conclude in as few as one test attempt. However, this diagnostic may require as many as 18 test attempts, which would require at least 3 drive cycles. Each test attempt concludes within 15 seconds.

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

- The catalyst test may abort due to a change in the engine load. Do not change the engine load, ensure the AC is OFF, the coolant fan is not cycling, while a catalyst test is in progress.
- Driving the vehicle under the conditions outlined in the Inspection/Maintenance (I/M) section can verify whether the fault is present.
- 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 Testing for Intermittent Conditions and Poor Connections.

Test Description

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

5. 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 steps inspects for conditions than can cause the TWC efficiency to appear degraded.

DTC P0420 or P0430				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Review the DTC information on the scan tool. Are any other DTCs set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	**IMPORTANT:** *A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.* 1. Start and idle the engine. 2. Allow the engine to reach operating temperature. 3. Increase the engine speed to 2,000 RPM for 2 minutes. 4. Ensure Closed Loop operation is enabled. 5. Return the engine to a stabilized idle. 6. Observe the HO2S 2 voltage parameter on the scan tool for the applicable bank. Is the applicable 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 P0430 set?	—	Go to Step 5	Go to Diagnostic Aids

DTC P0420 or P0430				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *Verify that the three-way catalytic converter (TWC) is a high quality part that meets the original equipment manufacturer (OEM) specifications.* Visually and physically inspect the TWC for the following conditions: • Physical damage • Severe discoloration caused by excessive temperatures • Internal rattles caused by loose catalyst substrate • Restrictions--Refer to Restricted Exhaust. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	Visually inspect the exhaust system for the following conditions: • Leaks • 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

DTC P0420 or P0430				
Step	**Action**	**Value(s)**	**Yes**	**No**
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	**NOTICE** *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 TWC. 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. **CAUTION:** ***Refer to Road Test Caution in Cautions and Notices.*** **IMPORTANT:** *A new converter with less than 100 miles on it may set DTC P0420 or P0430 due to out-gassing of the internal matting. Operating the vehicle at highway speeds for approximately 1 hour may correct the condition.* 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

DTC P0420 or P0430				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	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 in) 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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0442 Evaporative Emission (EVAP) System Small Leak Detected

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0125, P0335, P0336, P0443, P0446, P0449, P0451, P0452, P0453, P0454, P0455, P0464, P0496, P0500, P0502, P1106, P1107, P2610 are not set.
- The diagnostic runs once with a 10 hour minimum between tests after a fail.
- 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 greater than 74 kPa.
- The ambient air temperature is between 2-32°C (36-90°F).
- The engine run time minimum is 600 seconds.
- The odometer displays greater 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.
- One test occurs at ignition OFF after a cold start drive cycle and may require up to 45 minutes to complete. For the controller to report a fail, several tests must be completed with at least 17 hours between each test.

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.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. This condition may be detected by using a scan tool PURGE/SEAL function to seal the EVAP system and create a vacuum. Then observe the FTP parameter for vacuum decay.
- 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 Testing for Intermittent Conditions and Poor Connections.

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**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**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 (0.020 in) test orifice on the bottom-front of the J 41413-200 Evaporative Emissions System Tester (EEST). 3. Activate the J 41413-200 with the remote switch. 4. Align the red flag on the flow meter with the floating indicator. De-activate the J 41413-200 with the remote switch 5. Install the J 41415-40 Fuel Tank Cap Adapter or GE-41415-50 Fuel Tank Cap Adapter 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 evaporative emissions (EVAP) canister vent solenoid valve closed with a scan tool. 9. Introduce nitrogen and fill the EVAP system until the floating stabilizes with the remote switch. 10. Compare the flow meter stable floating indicator position to the red flag. Is the floating indicator below the red flag?	—	Go to Diagnostic Aids	Go to Step 3

DTC P0442				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 power supply clips to a known good 12-volt source. 3. Install the J 41415-40 or GE-41415-50 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

DTC P0442				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	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 5	Go to Diagnostic Aids

DTC P0442				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.* **NOTICE:** *Follow the operating instructions of the evapo-erative emissions in use.* 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.50 mm (0.020 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. Have any more DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 7

DTC P0442				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	**IMPORTANT:** *The malfunction indicator lamp (MIL) may remain ON after the repair unless the DTCs are cleared.* Clear the DTCs with the scan tool. Did you complete the action?	—	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.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0443 Evaporative Emission (EVAP) Purge Solenoid Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 10-18 volts.
- DTC P0443 runs continuously once the above conditions are met.

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 PWM. You should hear a clicking sound when the EVAP canister purge solenoid valve is commanded to 50 percent. The clicking sound should stop when the EVAP canister purge solenoid valve is commanded to 0 percent. The rate at which the valve cycles should increase when the commanded state is increased, and decrease when the commanded state is decreased.
5. This step verifies that the control module is providing ground to the EVAP canister purge solenoid valve.
6. This step tests if a ground is constantly being applied to the EVAP canister purge solenoid valve.

DTC P0443				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister purge solenoid valve to 50 percent, then to 0 percent with a scan tool. Does the EVAP canister purge solenoid valve respond to the commanded state?	—	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the EVAP canister purge solenoid valve harness 3. 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

DTC P0443				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Connect a test lamp between the control circuit of the EVAP canister purge solenoid valve and the 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 illuminate?	—	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 for a short to voltage. Refer to Circuit Testing and Wiring Repairs. 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. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
9	Inspect for poor connections at the harness connector of the EVAP canister purge solenoid valve. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P0443				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Repair the open or short to ground in the ignition 1 voltage circuit. Refer to Wiring Repairs. 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 powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—
14	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 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 - Vehicle	System OK

DTC P0446

System Description

This DTC tests the Evaporative Emission (EVAP) System for a restricted or blocked EVAP 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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0446 Evaporative Emission (EVAP) Vent System Performance

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0451, P0452, P0453, P0454, P0455, P0464, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is greater 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.
- DTC P0446 runs once per cold start when the above conditions are met.

Conditions for Setting the DTC

- The fuel tank pressure sensor is less than -12 inches H_2O.
- The above condition is 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.

Diagnostic Aids

- When using the electronic emission system tester (EEST) to apply pressure, you can regulate the amount of pressure by activating the remote switch ON and OFF while observing pressure in the EVAP system using a scan tool. DO NOT use more than 5 inches H2O. More than 5 inches H2O applied to the EVAP system can cause the canister vent solenoid valve to temporarily remain in the closed position, which could lead to misdiagnosis in this procedure.
- 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 Testing for Intermittent Conditions and Poor Connections.
- An EVAP canister, vent hose or vent solenoid valve that has restricted flow may cause this DTC to set. Using purge solenoid valve command with a scan tool, will allow vacuum to be applied to the system instead of pressure. With the EVAP canister vent solenoid valve open and the EVAP canister purge solenoid valve commanded to 100 percent, vacuum should not increase to more than 9 inches H2O.

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Inspect the Evaporative Emission (EVAP) System for the following conditions: • A damaged EVAP canister vent solenoid valve. • A pinched EVAP 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. Remove the fuel filler cap. 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

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	**NOTICE:** *Follow the operating instructions of the evaporative emissions in use.* 1. Turn OFF the ignition. 2. Connect J 41413-200 Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 3. Install J 41415-40 Fuel Tank Cap Adapter or GE-41415-50 Fuel Tank Cap Adapter to the fuel fill pipe. 4. Connect the fuel fill cap to J 41415-40 or to GE-41415-50. 5. Connect J 41413-200 nitrogen/smoke supply hose to J 41415-40 or to GE-41415-50. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP canister vent solenoid valve closed with a scan tool. 8. Turn the nitrogen/smoke valve on J 41413-200 control panel to NITROGEN. **IMPORTANT:** **DO NOT exceed the specified value in this step. Exceeding the specified value may cause the EVAP canister vent solenoid valve to remain closed, or produce incorrect test results.** 9. Use the remote switch to pressurize the EVAP system to the first specified value. 10. Observe the fuel tank pressure sensor in H2O with a scan tool. 11. 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 5	Go to Step 7

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Connect the J 41413-200 nitrogen/smoke supply hose and the vehicle fuel fill cap to the J 41415-40 or GE-41415-50. 2. Start the engine. 3. Allow the engine to idle. 4. Use the purge/seal function to seal the system with a scan tool. 5. Command the EVAP canister purge solenoid valve to 20 percent. 6. Observe the vacuum/pressure gage of the J 41413-200 and the FTP parameter on the scan tool. 7. Allow the vacuum to increase on the gage of the J 41413-200 until it reaches approximately 16 inches H2O. Did the pressure reading on the gauge agree with the scan tool FTP parameter until the vacuum reached the abort limit on the scan tool?	—	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 12
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 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 for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	Repair the pinched or restricted EVAP 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. 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. Remove the fuel filler cap. 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

DTC P0446				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	**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 J 41413-200 to the fuel fill pipe. 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 J 41413-200 control panel to NITROGEN. 7. 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. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0449

Circuit Description

A battery positive 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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0449 Evaporative Emission (EVAP) vent Solenoid Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 10-18 volts.
- DTC P0449 runs continuously once the above conditions are met.

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. Listen for a click when the valve operates. Verify that both the ON and the OFF states are commanded.
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**	**Value(s**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister vent solenoid valve ON and OFF with the scan tool. Do you hear or feel a click from the EVAP canister vent solenoid valve when the valve 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 Testing for Intermittent Conditions and Poor Connections
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 battert positive voltage circuit of the EVAP canister vent solenoid valve with a test lamp connected to a good ground. Refer to Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 11

DTC P0449				
Step	**Action**	**Value(s**	**Yes**	**No**
5	1. Connect a test lamp between the control circuit of the EVAP canister vent solenoid valve and battery positive voltage circuit of the EVAP canister vent solenoid valve at the EVAP canister vent solenoid valve harness connector. 2. Command the EVAP canister vent solenoid valve ON and OFF with a scan tool. Does the test lamp turn ON and 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 of the EVAP canister vent solenoid valve for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
8	Test the control circuit of the EVAP canister vent solenoid valve for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
9	Inspect for poor connections at the harness connector of the EVAP canister vent solenoid valve. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P0449				
Step	**Action**	**Value(s**	**Yes**	**No**
11	**IMPORTANT:** *If the fuse is open, inspect all related circuits for a short to ground.* Repair the open or short to ground in the battery positive voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 14	—
12	Replace the EVAP canister vent solenoid valve. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—
14	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 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 - Vehicle	System OK

DTC P0451

System Description

The fuel tank pressure (FTP) sensor measures air pressure or vacuum in the Evaporative Emission (EVAP) System. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal voltage varies, depending on EVAP System pressure or vacuum. The controller uses this FTP signal to determine atmospheric pressure for use in the engine-off small leak test, P0442. Before using this signal as an atmospheric reference, it must first be re-zeroed. If the FTP signal is out of range during the re-zero procedure, this DTC will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0451 Fuel Tank Pressure (FTP) Sensor Performance

Conditions for Running the DTC

- DTC P0451 runs only when the engine-off natural vacuum small leak test, DTC P0442, executes.
- The number of times this test runs can range from 0-2 per engine-off period. The length of the test can be up to 40 minutes.

Conditions for Setting the DTC

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

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 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 DTC with a scan tool.

Diagnostic Aids

- When using the J 41413-200 Evaporative Emission System Tester (EEST) to apply pressure, you can regulate the amount of pressure by activating the remote switch ON and OFF while observing pressure in the EVAP system using a scan tool.
- A restriction in the EVAP canister or vent lines could prevent fuel vapor pressure from bleeding off fast enough. If the vent system cannot bleed off pressure fast enough, this code can set. When pressure is applied to the system and released, a properly operating system will return to the atmospheric pressure rapidly. By using a scan tool and the J 41413-200 pressure can be applied to the system, then released, while monitoring the FTP Sensor parameter to see that pressure can be released within 30 seconds.
- An FTP sensor that is skewed or does not have a linear transition from low to high may cause this code to set. A scan tool output controls, snapshot, and plot functions can help detect erratic sensor response. To test the sensor signal under vacuum conditions, use the Quick Snapshot and the Purge/Seal functions to capture data while commanding purge to 20 percent, then plot the data to look for erratic sensor operation. A similar test can be done for the pressure side of the sensor operation by applying pressure with the J 41413-200 while taking a snapshot.
- A full fuel tank may cause misdiagnosis.

Test Description

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

4. This step tests for the signal voltage that represents atmospheric pressure. Removing the fuel fill cap ensures a vented EVAP System. Record the value for possible use later in the diagnostic table.
5. This step tests the accuracy of the FTP sensor by comparing the electrical signal value to the EEST mechanical gage value.
8. A restricted EVAP System will not allow the nitrogen to flow freely through the system. A restriction will cause the FTP Signal Voltage parameter to decrease as the pressure builds.

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC P0446, P0452, P0453, or P0651 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Inspect the Evaporative Emission (EVAP) System for the following conditions: • A damaged EVAP canister vent solenoid valve. • A pinched EVAP hose • A damaged EVAP canister--Refer to Evaporative Emission (EVAP) Canister Replacement. Did you find and correct the condition?	—	Go to Step 17	Go to Step 4
4	1. Remove the fuel fill cap. 2. Turn ON the ignition, with the engine OFF. 3. Observe and record the Fuel Tank Pressure (FTP) parameter in volts with a scan tool. Is the Fuel Tank Pressure Sensor parameter within the specified amount?	1.3-1.7 V	Go to Step 5	Go to Step 14

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	**IMPORTANT:** *Ensure that the vehicle underbody temperature is similar to the ambient temperature.* 1. Turn OFF the ignition. 2. Install the fuel fill cap. 3. Connect the J 41413-200 Evaporative Emission System Tester (EEST) power supply clips to a known good 12-volt source. 4. Install the J 41415-40 Fuel Tank Cap Adapter or the GE-41415-50 Fuel Cap Adapter to the fuel fill pipe. 5. Connect the J 41413-200 NITROGEN/SMOKE supply hose to the J 41415-40 or the GE-41415-50 to the fuel fill pipe. 6. Turn the ignition ON, with the engine OFF. 7. Turn the NITROGEN/SMOKE valve on the J 41413-200 to NITROGEN. 8. Using a scan tool PURGE/SEAL function, seal the EVAP System. 9. Observe the fuel tank pressure sensor in H2O using a scan tool. 10. Use a remote switch to pressurize the EVAP System to the first specified value. 11. Allow at least 30 seconds for pressure in the EVAP System to stabilize. Compare the FTP parameter in H2O to the J 41413-200 VACUUM/PRESSURE gage. Is the difference between the FTP parameter on a scan tool and the VACUUM/PRESSURE gage on the J 41413-200 within the second specified value?	5 in H2O 1 in H2O	Go to Step 6	Go to Step 14

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Release the pressure on the EVAP System with the scan tool. Is the difference between the FTP parameter on the scan tool and the VACUUM/PRESSURE gage on the J 41413-200 within the specified value?	1 in H2O	Go to Step 7	Go to Step 14
7	1. Start the engine. 2. Allow the engine to idle. **IMPORTANT:** *Using more than 20 percent purge can cause a misdiagnosis.* 3. Use the PURGE/SEAL function of a scan tool to command 20 percent purge. 4. Observe the VACUUM/PRESSURE gage on the J 41413-200 and the FTP parameter on the scan tool. Allow the vacuum to increase to the first specified value. Is the difference between the FTP parameter on the scan tool and the VACUUM/PRESSURE gage on the J 41413-200 within the second specified value?	5 in H2O	Go to Step 8	Go to Step 14
8	1. Turn ON the ignition, with the engine OFF. 2. Turn the NITROGEN/SMOKE valve on the J 41413-200 to NITROGEN 3. Observe the FTP sensor in volts using a scan tool. 4. Pressurize the EVAP System with the remote switch. 5. Allow enough time for pressure to stabilize. Is the difference between the observed FTP sensor voltage and the voltage recorded in Step 4 more than the specified value?	0.2 V	Go to Step 9	System OK

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Disconnect the EVAP vapor pipe from the EVAP canister with pressure still applied from the J 41413-200. 2. Observe the FTP sensor in volts using a scan tool. Is the difference between the observed FTP sensor voltage and the voltage recorded in Step 4 more than the specified value?	0.2 V	Go to Step 10	Go to Step 11
10	1. Disconnect the EVAP vapor pipe from the EVAP canister with pressure still applied from the evap tester. 2. Observe the FTP sensor in volts using a scan tool. Is the difference between the observed FTP sensor voltage and the voltage recorded in Step 4 more than the specified value?	0.2 V	Go to Step 13	Go to Step 12
11	Repair or replace the EVAP canister vent solenoid. Did you complete the action?	—	Go to Step 17	—
12	Replace the EVAP canister. Refer to Evaporative Emission (EVAP) Canister Replacement. Did you complete the replacement?	—	Go to Step 17	—
13	Repair or replace the pinched or restricted EVAP vapor pipe. Did you complete the action?	—	Go to Step 17	—

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	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. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
15	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
16	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all components and release any pressure or vacuum applied to the EVAP System. 2. Turn ON the ignition, with the engine OFF. 3. Observe and record the FTP parameter in H2O with a scan tool. Is the Fuel Tank Pressure Sensor parameter within the specified amount?	-1 to +1 in H2O	Go to Step 18	Go to Step 2

DTC P0451				
Step	**Action**	**Value(s)**	**Yes**	**No**
18	1. Turn ON the ignition, with the engine OFF. 2. Command the EVAP canister vent solenoid closed with a scan tool. 3. Turn the NITROGEN/SMOKE valve on the J 41413-200 to NITROGEN. 4. Pressurize the EVAP System to the first specified value with the remote switch. 5. Observe the fuel pressure sensor in H2O using a scan tool. 6. 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	Go to Step 19	Go to Diagnostic Aids
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 - Vehicle	Go to Step 20
20	**IMPORTANT:** *The malfunction indicator lamp (MIL) may remain ON after the repair unless the DTCs are cleared.* Clear the DTCs with a scan tool. Did you complete the action?	—	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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0452 Fuel Tank Pressure (FTP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0452 runs continuously once the above condition is met.

Conditions for Setting the DTC

- The FTP sensor voltage is less than 0.1 volts.
- All conditions are 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 numbers below refer to the step numbers on the diagnostic table.

5. This step 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				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with a scan tool. Did DTC P0641 or P0651 fail this ignition?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Observe the fuel tank pressure sensor parameter with the scan tool. Does the scan tool indicate that fuel tank pressure sensor parameter is 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 Testing for Intermittent Conditions and Poor Connections

DTC P0452				
Step	**Action**	**Value(s**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Raise and support the vehicle. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the fuel tank pressure (FTP) sensor and the signal circuit of the FTP sensor. 5. Turn ON the ignition, with the engine OFF. 6. Observe the fuel tank pressure sensor voltage with a scan tool. Is the fuel tank pressure sensor parameter greater than the specified value?	4.8 V	Go to Step 8	Go to Step 6
6	Test the 5-volt reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test the signal circuit of the FTP sensor for a short to ground, or an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Remove the fuel tank. 2. Inspect the fuel tank wiring harness for the following: – Damaged wiring – Poor connections – Broken wires inside the insulation Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P0452				
Step	**Action**	**Value(s**	**Yes**	**No**
9	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. 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 powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—
12	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 2	Go to Step 13
13	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0453 Fuel Tank Pressure (FTP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0453 runs continuously once the above condition is met.

Conditions for Setting the DTC

- The FTP sensor voltage is more than 4.9 volts.
- All conditions are 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 P0641 or P0651 is set, the 5-volt reference circuit may be shorted to a voltage.

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Did DTC P0641 or P0651 fail this ignition?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the fuel tank pressure sensor voltage 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 Testing for Intermittent Conditions and Poor Connections

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Raise and support the vehicle. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Observe the fuel tank pressure (FTP) sensor voltage with a scan tool. Does the scan tool indicate that the Fuel Tank Pressure Sensor parameter is more than the specified value?	1 V	Go to Step 6	Go to Step 7
6	Test the signal circuit of the FTP for a short to voltage between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	Probe the low reference circuit of the FTP sensor at the fuel tank harness connector with a test lamp connected to battery voltage. Refer to Circuit Testing. Did the test lamp illuminate?	—	Go to Step 9	Go to Step 8
8	Test the low reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	1. Remove the fuel tank. 2. Disconnect the FTP sensor harness connector. 3. Inspect the fuel tank wiring harness for the following: - Damaged wiring - Poor connections - Broken wires inside the insulation--Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	Inspect for poor connections at the harness connector of the control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. 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 powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 13	—
13	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 2	Go to Step 14

DTC P0453				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0454

System Description

The fuel tank pressure (FTP) sensor measures air pressure or vacuum in the Evaporative Emission (EVAP) System. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal voltage varies depending on EVAP System pressure or vacuum. The controller uses this FTP signal to determine atmospheric pressure for use in the engine OFF small leak test, P0442. This DTC will set if the control module detects an intermittent signal from the FTP that would prevent the engine-off small leak test, P0442, from running.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0454 Fuel Tank Pressure (FTP) Sensor Circuit Intermittent

Conditions for Running the DTC

- DTC P0454 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- This test can run once per engine-off period. The length of the test can be up to 40 minutes.

Conditions for Setting the DTC

If, during the engine-off natural vacuum small leak test, P0442, the powertrain control module (PCM) detects an abrupt FTP signal change, other than a refueling event, this DTC will set.

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 MIL after 3 consecutive gnition 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 DTC with a scan tool.

Diagnostic Aids

Scan tool output controls, snapshot, and plot functions can help detect erratic sensor response. To look at the sensor signal under vacuum conditions, use snapshot and the purge/seal function to capture data while commanding purge to 20 percent, then plot the data to look for non-linear sensor operation. A similar inspection can be done for the pressure side of the sensor range by applying pressure with the J 41413-200 Evaporative Emissions System Tester (EEST) while taking a snapshot. DO NOT exceed 5 inches H2O when applying pressure.

Test Description

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

3. Sealing the system will allow normal pressure in the EVAP System to preload the sensor. This will help put the sensor in a range that is more sensitive, making the test more accurate.

DTC P0454				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Are DTCs P0442, P0446, P0452, P0453, or P0651 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Inspect for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	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 - Vehicle	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.

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0455 Evaporative Emission (EVAP) System Large Leak Detected

Conditions for Running the DTC

- Before the powertrain control module (PCM) can report DTC P0455 failed, DTC P0496 must run and pass.
- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0451, P0452, P0453, P0454, P0464, P0496, P0502, P0503, P1111, P1112, P1114, P1115, P1125, P1122, P1121, P2135 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 4-65°C (39-149°F).
- The intake air temperature (IAT) is between 4-75°C (39-167°F).
- The start-up ECT and IAT are within 9°C (16°F) of each other.
- DTC P0455 runs once per cold start.

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.
- For intermittent conditions, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. 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.
6. This step verifies proper operation of the FTP sensor.
7. A normal operating FTP sensor should increase above 5 inches of H_2O and stop between 6-7 inches of H_2O.

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Inspect the evaporative emission (EVAP) system for the following conditions: – Loose, missing, or damaged service port schrader valve – Loose, incorrect, missing, or damaged fuel fill cap – A damaged EVAP canister purge solenoid valve 2. Raise the vehicle on a hoist. 3. Inspect the EVAP system for the following conditions: – 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

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
3	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 (0.020 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 the GE-41415-50 Fuel Tank Cap Adapter to the fuel fill pipe. 8. Install the fuel fill cap to the J 41415-40 or the GE-41415-50. 9. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the J 41415-40 or the 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 introduce nitrogen and fill the EVAP system until the floating indicator stabilizes. 13. Compare the flow meter stable floating indicator position to the red flag. Is the floating indicator below the red flag?	—	Go to Step 6	Go to Step 4

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 or GE-41415-50 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 locted Did you locate and repair the leak source?	—	Go to Step 21	Go to Step 5

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 difference between the 2 gages less than the specified value?	1 in H2O	Go to Step 7	Go to Step 14
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. Is the fuel tank pressure sensor parameter more than the second specified value?	13 in H2O 5 in H2O	Go to Step 8	Go to Step 14

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Stop introducing nitrogen into the EVAP system with the remote switch. 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 purge solenoid valve to 30 percent. 8. Observe the vacuum/pressure gage on the J 41413-200 and the FTP parameter on the scan tool. 9. Use the purge/seal function to seal the system, with a scan tool. Is the difference between the FTP parameter on a scan tool and the vacuum/pressure gage on the J 41413-200 within the specified value, until the vacuum reached the abort limit on the scan tool?	1 in H2O	Go to Step 10	Go to Step 14
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 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 12

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Disconnect the EVAP 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 13
13	Disconnect the EVAP 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
14	Test for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 15
15	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 17
16	Repair the pinched or obstructed EVAP vapor pipe. Did you complete the repair?	—	Go to Step 21	—
17	Replace the 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	—

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Repair the restriction in the EVAP purge pipe. Refer to Evaporative Emission (EVAP) Hoses/Pipes Replacement - Engine/Chassis.	—	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. Does the J 41413-200 pressure/vacuum gage remain constant?	5 in H2O	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 11

DTC P0455				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0461

Circuit Description

The fuel level sensor changes resistance in response to the fuel level. The powertrain control module (PCM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM senses a high signal voltage. The PCM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM sends the fuel level percentage via the class 2 serial data circuit to the instrument cluster in order to control the fuel gage. The fuel level information is also used for misfire and evaporative emissions (EVAP) diagnostics.

This diagnostic tests for a stuck fuel level sensor signal. The PCM sets this DTC if the fuel level sensor signal appears to be stuck based on a lack of signal variation expected during normal operation.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0461 Fuel Level Sensor 1 Performance

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The PCM does not detect a change in fuel level of at least 3.0L (0.79 gal) over a distance of 320 km (200 mi).

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM records the operating conditions at the time that the diagnostic test fails. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present..
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

Use the Freeze Frame/Failure Records data in order to locate an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame/Failure Records data may help in determining the number of miles since the DTC set. The Fail Counter and Pass Counter can also help in determining the number of ignition cycles that the diagnostic test reported a pass and/or fail. Operate the vehicle within the same Freeze Frame conditions, including those for RPM, for engine load, for vehicle speed, for temperature, and for others. This will isolate at what point the DTC failed. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems.

DTC P0461			
Step	**Action**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	1. Remove the fuel level sender. 2. Inspect for the following items: – The fuel level sensor is stuck, perhaps due to an interference with the fuel strainer. – The fuel tank contains foreign material, for instance, ice. Did you find and correct the condition?	Go to Step 4	Go to Step 3
3	Replace the fuel level sensor. Refer to the following procedures: • Fuel Level Sensor Replacement in Engine Controls - 6.0L • Fuel Level Sensor Replacement in Engine Controls - 8.1L Did you complete the replacement?	Go to Step 4	—
4	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to Step 2	System OK

DTC P0462

Circuit Description

The fuel level sensor changes resistance in response to fuel level. The powertrain control module (PCM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM senses a high signal voltage. The PCM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM sends the fuel level percentage via the class 2 serial data circuit to the instrument cluster in order to control the fuel gage. The fuel level information is also used for misfire and evaporative emission (EVAP) diagnostics.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0462 Fuel Level Sensor 1 Circuit Low Voltage

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The sender output is less than 0.39 volts.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM records the operating conditions at the time that the diagnostic test fails. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

Use the Freeze Frame/Failure Records data in order to locate an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame/Failure Records data may help in determining the number of miles since the DTC set. The Fail Counter and Pass Counter can also help in determining the number of ignition cycles that the diagnostic test reported a pass and/or fail. Operate the vehicle within the same freeze frame conditions, including those for RPM, for engine load, for vehicle speed, for temperature, and for others. This will isolate at what point the DTC failed.

Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems.

Test Description

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

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

DTC P0462				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List in Wiring Systems				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle in Vehicle DTC Information
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. With the scan tool, observe one of the following fuel level parameters: – Fuel Tank Level Remaining parameter in the powertrain control module (PCM) Enhanced evaporative emission (EVAP) Data, data list-gas only. Does the scan tool indicate that the Fuel Tank Level Remaining parameter is greater than the specified value or the Fuel Level Sensor parameter is less than the specified value?	98%	Go to Step 3	Go to Diagnositic Aids
3	1. Turn the ignition OFF. 2. Disconnect C152. 3. Turn the ignition ON, with the engine OFF. 4. With the scan tool, observe the fuel level parameter. Does the scan tool indicate that the Fuel Tank Level Remaining parameter is less than the specified value or the Fuel Level Sensor parameter is greater than the specified value?	4%	Go to Step 5	Go to Step 4
4	Test the signal circuit of the fuel level sensor 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 10	Go to Step 7
5	Test the signal circuit of the fuel level sensor for a short to ground between C152 and the fuel level sensor. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6

DTC P0462				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Inspect for poor connections at the harness connector of the fuel level 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 10	Go to Step 8
7	Inspect for poor connections at the harness connector of 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 10	Go to Step 9
8	Replace the fuel level sensor. Refer to the following procedures: • Fuel Level Sensor Replacement in Engine Controls – 6.0L • Fuel Level Sensor Replacement in Engine Controls – 8.1L Did you complete the replacement?	—	Go to Step 10	—
9	Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 10	—
10	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0463

Circuit Description

The fuel level sensor changes resistance in response to fuel level. The powertrain control module (PCM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM senses a high signal voltage. The PCM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM sends the fuel level percentage via the class 2 serial data circuit to the instrument cluster in order to control the fuel gage. The fuel level information is also used for misfire and evaporative emission (EVAP) diagnostics.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0463 Fuel Level Sensor 1 Circuit High Voltage

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The sender output is greater than 2.9 volts.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM records the operating conditions at the time that the diagnostic test fails. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

Use the Freeze Frame/Failure Records data in order to locate an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame/Failure Records data may help in determining the number of miles since the DTC set. The Fail Counter and Pass Counter can also help in determining the number of ignition cycles that the diagnostic test reported a pass and/or fail. Operate the vehicle within the same freeze frame conditions, including those for RPM, for engine load, for vehicle speed, for temperature, and for others. This will isolate at what point the DTC failed.

Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems.

Test Description

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

3. Tests for the proper operation of the circuit in the low voltage range.

DTC P0463				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List in Wiring Systems				
1	Did you perform the Diagnostic System Check - Vehicle?	–	Go to Step 2	Go to Diagnostic System Check – Vehicle in Vehicle DTC Information
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. With the scan tool, observe one of the following fuel level parameters: – Fuel Tank Level Remaining parameter in the powertrain control module (PCM) Enhanced evaporative emission (EVAP) Data, data list-gas only. Does the scan tool indicate that the Fuel Tank Level Remaining parameter is less than the specified value or the Fuel Level Sensor parameter is greater than the specified value?	4%	Go to Step 3	Go to Diagnositic Aids
3	1. Turn the ignition OFF. 2. Disconnect C152. 3. Connect a 3-amp fused jumper wire between the signal circuit of the fuel level sender and the low reference circuit of the fuel level sender on the male terminal side. 4. Turn the ignition ON, with the engine OFF. 5. With the scan tool, clear the DTCs. 6. With the scan tool, observe the Fuel Level parameter. Does the scan tool indicate that the Fuel Tank Level Remaining parameter is greater than the specified value or the Fuel Level Sensor parameter is less than the specified value?	98%	Go to Step 6	Go to Step 4
4	Test the signal circuit of the fuel level sensor for an open, for a high resistance, or 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 12	Go to Step 5

DTC P0463				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the low reference circuit of the fuel level sensor for an open, for a high resistance, or 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 12	Go to Step 9
6	Test the signal circuit of the fuel level sensor for an open, for a high resistance, or for a short to voltage between C152 and the fuel level sensor. 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
7	Test the low reference circuit of the fuel level sensor for an open, for a high resistance, or for a short to voltage between C152 and the fuel level sensor. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	Inspect for poor connections at the harness connector of the fuel level 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	Inspect for poor connections at the harness connector of 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 12	Go to Step 11
10	Replace the fuel level sensor. Refer to the following procedures: • Fuel Level Sensor Replacement in Engine Controls – 6.0L • Fuel Level Sensor Replacement in Engine Controls – 8.1L Did you complete the replacement?	—	Go to Step 12	—

DTC P0463				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Replace the PCM. Refer to Control Module References in Computer/ Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—
12	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0464

Circuit Description

The powertrain control module (PCM) monitors the signal circuit of the fuel level sender in order to determine fuel level. The sender consists of a variable resistor that changes resistance based on the fuel level in the tank. The PCM monitors the voltage across the sender resistance in order to determine the fuel level. The PCM uses the signal circuit of the fuel level sender in order to calculate the total remaining fuel, in percent. The PCM sends the fuel level percent via the serial data circuit to the instrument cluster in order to control the fuel gage. The fuel level information is also used for misfire and evaporative emission (EVAP) diagnostics.

This diagnostic tests for an intermittent fuel level sender signal. If a change in fuel level is detected DTC P0442 is aborted due to a refueling event. A refueling event test is executed to confirm that a refueling event has occurred. If refueling is confirmed, the test is considered passing. Otherwise, the DTC will set indicating an intermittent signal problem.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0464 Fuel Level Sensor 1 Circuit Intermittent

Conditions for Running the DTC

- The ignition is OFF.
- DTC P0442 is running.

Conditions for Setting the DTC

- The fuel level change is greater than 10 percent.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- DTC P0442 is aborted.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

- Use the Freeze Frame and/or Failure Records data in order to locate an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame and/or Failure Records data may aid in determining the number of miles since the DTC set. The Fail Counter and Pass Counter can also aid in determining the number of ignition cycles that the diagnostic reported a pass and/or fail. Operate the vehicle within the same freeze frame conditions, i.e. RPM, engine load, vehicle speed, temperature, etc. This will isolate when the DTC failed. Refer to Testing for Intermittent Conditions and Poor Connections.
- If the DTC sets without a refueling event, refer to Fuel Gage Inaccurate or Inoperative.

DTC P0496

System Description

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

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

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0496 Evaporative Emission (EVAP) System Flow During Non-Purge

Conditions for Running the DTC

- DTC P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0452, P0453, P0455, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is greater 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 8°C (14°F) of each other.
- DTC P0496 runs continuously when these conditions are met.

Conditions for Setting the DTC

- A continuous open purge flow condition is detected during the diagnostic test.
- The fuel tank pressure decreases to less than a calibrated value.

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 P0496				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Seal the Evaporative Emission (EVAP) System using the Purge. Seal function with a scan tool. 3. Increase the engine idle to 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified value?	-1 to +1 H2O	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the EVAP purge pipe from the EVAP purge solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 H2O	Go to Step 4	Go to Step 5
4	Replace the EVAP purge solenoid valve. Refer to Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
5	Replace the fuel tank pressure (FTP) sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 6	—

DTC P0496				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect all EVAP hardware that was previously disconnected. 2. Seal the EVAP system using the Purge/Seal function with a scan tool. 3. Start the engine and idle at 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor parameter with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 $H2O$	Go to Step 7	Go to Step 2
7	Observe the Capture Info with a scan tool. Have any other DTCs not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0506 or P0507

Circuit Description

The throttle actuator control (TAC) system uses vehicle electronics and components to calculate and control the position of the throttle plate. In order to decrease idle speed the TAC system closes the throttle plate reducing airflow into the engine. In order to increase idle speed the TAC system opens the throttle plate allowing more airflow into the engine. If the actual idle RPM does not match the desired idle RPM within a calibrated time, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0506 Idle Speed Low
- DTC P0507 Idle Speed High

Conditions for Running the DTC

- DTCs P0068, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0171, P0172, P0200, P0220, P0300, P0336, P0401, P0404, P0405, P0442, P0446, P0452, P0453, P0641, P0651, P1516, P2101, P2135 are not set.
- The engine is operating for at least 2 seconds.
- The engine coolant temperature (ECT) is more than -40°C (-40°F).
- The intake air temperature (IAT) is more than -40°C (-40°F).
- The barometric pressure (BARO) is more than 65 kPa.
- The system voltage is between 9-18 volts.
- The vehicle speed is less than 4.8 km/h (3 mph).
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The actual idle speed is approximately 150 RPM lower than or 100 RPM more than the desired idle speed.
- The above condition is present for 15 seconds.

Action Taken When the DTC Sets

The PCM will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test has been run and failed.

The PCM will store conditions which were present when the DTC set as Freeze Frame/Failure Records data.

Conditions for Clearing the MIL/DTC

The PCM will turn OFF the malfunction indicator lamp (MIL) during the third consecutive trip in which the diagnostic has run and passed.

The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

The DTC can be cleared by using a scan tool.

Diagnostic Aids

If the condition is intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. This test determines whether the engine can achieve the commanded RPM. If the engine does not reach the commanded RPM, the test determines whether the RPM is too high or too low.

DTC P0506 or P0507				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Command the engine speed up to 1,500 RPM, down to 500 RPM, and up to 1,500 RPM with a scan tool. 3. Exit the engine speed control function. Does the engine speed correspond, within 100 RPM, with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	Is the engine RPM 100 RPM more than the desired RPM?	—	Go to Step 4	Go to Step 5
4	Inspect for the following conditions: • Vacuum leaks • Excessive deposits in the throttle body • A faulty positive crankcase ventilation system Did you complete the repair?	—	Go to Step 6	—
5	Inspect for energy draining load on the engine, such as ones caused by transmission conditions. Did you find and correct the condition?	—	Go to Step 6	—
6	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 7

DTC P0506 or P0507				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P0522

Circuit Description

The engine oil pressure (EOP) sensor changes resistance based on engine oil pressure. The powertrain control module (PCM) monitors the signal circuit of the EOP sensor. When the oil pressure is high, the sensor resistance is high, and the PCM senses a high signal voltage. When the oil pressure is low, the sensor resistance is low, and the PCM senses a low signal voltage. The PCM sends the engine oil pressure information to the instrument panel cluster (IPC) via the class 2 serial data circuit.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0522 Engine Oil Pressure (EOP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0641 is not present.

Conditions for Setting the DTC

- The PCM detects that the EOP sensor signal circuit is less than 0.4 volt.
- The above condition is present for greater than 9 seconds.

Action Taken When the DTC Sets

- The PCM records the operating conditions at the time the diagnostic test fails. The PCM displays this information in the Failure Records on the scan tool.
- The IPC illuminates the engine oil pressure indicator.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives a clear code command from the scan tool.

Diagnostic Aids

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

Refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. This step tests for the proper operation of the circuit in the high voltage range.

DTC P0522				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehiclenformation
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. With the scan tool, observe the Engine Oil Pressure Sensor parameter in the PCM Engine Data 2 data list. Does the scan tool indicate that the Engine Oil Pressure parameter is at or less than the specified value?	0.4 V	Go to Step 3	Go to Diagnositic Aids
3	Is DTC P0641 current in the powertrain control module (PCM)?	—	Go to DTC P0641	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the engine oil pressure (EOP) sensor. 3. Connect a 3-amp fused jumper between the EOP sensor signal circuit and the 5-volt reference circuit of the EOP sensor. 4. With the scan tool, observe the Engine Oil Pressure Sensor parameter in the PCM Engine Data 2 data list. Does the scan tool indicate that the Engine Oil Pressure parameter is at or greater than the specified value?	4.6 V	Go to Step 8	Go to Step 5
5	1. Disconnect the fused jumper. 2. Measure the voltage between the 5-volt reference circuit of the EOP sensor and the low reference circuit of the EOP sensor. Does the voltage measure greater than the specified value?	4.6 V	Go to Step 7	Go to Step 6
6	Test the 5 volt reference circuit of the EOP sensor for an open or for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9

DTC P0522				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Test the EOP sensor signal circuit for an open, for a short to ground, or for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	Inspect for poor connections at the harness connector of the EOP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the engine oil pressure sensor. Refer to the following procedures: • Engine Oil Pressure Sensor and/or Switch Replacement for the 6.0L engine • Engine Oil Pressure Sensor and/or Switch Replacement for the 8.1L engine Did you complete the replacement?	—	Go to Step 12	—
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—
12	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0523

Circuit Description

The engine oil pressure (EOP) sensor changes resistance based on engine oil pressure. The powertrain control module (PCM) monitors the signal circuit of the EOP sensor. When the oil pressure is high, the sensor resistance is high, and the PCM senses a high signal voltage. When the oil pressure is low, the sensor resistance is low, and the PCM senses a low signal voltage. The PCM sends the engine oil pressure information to the instrument panel cluster (IPC) via the class 2 serial data circuit.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0523 Engine Oil Pressure (EOP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0641 is not present.

Conditions for Setting the DTC

- The PCM detects that the EOP sensor signal circuit is greater than 4.6 volts.
- The above condition is present for greater than 9 seconds.

Action Taken When the DTC Sets

The PCM records the operating conditions at the time that the diagnostic test fails. The PCM displays this information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC is cleared after 40 malfunction-free warm-up cycles.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

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

Refer to Testing for Intermittent Conditions and Poor Connections

Test Description

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

3. This step tests for the proper operation of the circuit in the low voltage range.

DTC P0523				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	1. Install a scan tool. 2. Turn the ignition ON, with the engine OFF. 3. With the scan tool, observe the Engine Oil Pressure Sensor parameter in the PCM Engine Data 2 data list. Does the scan tool indicate that the Engine Oil Pressure parameter is at or greater than the specified value?	4.6 V	Go to Step 3	Go to Diagnositic Aids
3	1. Turn the ignition OFF. 2. Disconnect the engine oil pressure (EOP) sensor. 3. With the scan tool, observe the Engine Oil Pressure Sensor parameter in the PCM Engine Data 2 data list. Does the scan tool indicate that the Engine Oil Pressure parameter is at or less than the specified value?	0.4 V	Go to Step 4	Go to Step 5
4	1. Turn the ignition OFF. 2. Disconnect the negative battery cable. 3. Measure the resistance from the low reference circuit of the EOP sensor to a good ground. Is the resistance less than the specified value?	5 ohms	Go to Step 7	Go to Step 6
5	Test the EOP sensor signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8

DTC P0523				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Disconnect the powertrain control module (PCM). 2. Test the low reference circuit of the EOP sensor for an open or for a high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	Inspect for poor connections at the harness connector of the EOP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the engine oil pressure sensor. Refer to the following procedures: • Engine Oil Pressure Sensor and/or Switch Replacement for the 6.0L engine • Engine Oil Pressure Sensor and/or Switch Replacement for the 8.1L engine Did you complete the replacement?	—	Go to Step 11	—
10	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 11	—
11	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the powertrain control module (PCM). This diagnostic also addresses whether or not the PCM is not programmed.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0601 Control Module Read Only Memory (ROM)
- DTC P0602 Control Module Not Programmed
- DTC P0604 Control Module Random Access Memory (RAM)
- DTC P0606 Control Module Internal Performance
- DTC P2610 Control module Ignition Off Timer Performance

Conditions For Running The DTC

DTC P0601

- The ignition switch is in the Run or Crank position.
- DTC P0601 runs continuously when the above condition is met.

DTC P0602

- The ignition switch is in the ON position.
- DTC P0602 runs continuously when the above condition is met.

DTC P0604

- The ignition switch is in the Run or Crank position.
- DTC P0604 runs continuously when the above condition is met.

DTC P0606

- The ignition switch is in the Run or Crank position, or the key is being turned OFF.

- DTC P0606 runs continuously when the above condition is met.

DTC P2610

- The PCM is powered down.
- DTC P2610 runs once every time the key is turned OFF.

Conditions For Setting the DTC

The PCM detects an internal failure or incomplete programming for more than 5 seconds.

Action Taken When DTCs P0601, P0602, P0604, P0606 Set

- 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.

Action Taken When DTC P2610 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/DTCs P0601, P0602, P0604, P0606, P2610

- 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. A DTC P0602 indicates the PCM is not programmed.

DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC P0602 set?	—	Go to Step 3	Go to Step 5
3	Program the powertrain control module (PCM). Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Does DTC P0602 reset?	—	Go to Step 4	Go to Step 7
4	1. Ensure that all tool connections are secure. 2. Ensure that the programming equipment is operating correctly. 3. Ensure that the correct software/calibration package is used. 4. Attempt to program the PCM. Does DTC P0602 reset?	—	Go to Step 6	Go to Step 7
5	Test all voltage and ground inputs to the PCM 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 7	Go to Step 6
6	Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 7	—
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8

DTC P0601, P0602, P0603, P0604, P0605, P0606, P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle in Vehicle DTC Information	System OK

DTC P0608

Circuit Description

The powertrain control module (PCM) creates the vehicle speed output signal by pulsing the circuit to ground. The PCM pulses the circuit at the same rate as the vehicle speed signal input. The PCM monitors the voltage on the vehicle speed output circuit. If the PCM determines the voltage is out of the normal operating range, a DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0608 Vehicle Speed Output Circuit

Conditions for Running the DTC

- The engine speed is greater than 400 RPM.
- The ignition voltage is greater than 6 volts but less than 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 condition must be present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information in memory.
- The PCM records the operating conditions at the time the DTC sets. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The history DTC clears after 40 malfunction-free warm-up cycles.
- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

IMPORTANT:
Remove any debris from the PCM connector surfaces before servicing the PCM. Inspect the PCM connector gaskets when diagnosing/replacing the PCM. Ensure that the gaskets are installed correctly. The gaskets prevent water intrusion into the PCM.

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame and/or Failure Records data can aid in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also aid determining how many ignition cycles the diagnostic reported a pass and/or a fail. Operate the vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that you observed. This will isolate when the DTC failed.

For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0608				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	1. Turn the ignition OFF. 2. Raise the vehicle drive wheels. 3. Start the engine. 4. Place the transmission into drive for an automatic transmission or third gear for manual transmission. Does the vehicle speedometer indicate a vehicle speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the powertrain control module (PCM) connector C2. 3. Turn the ignition ON, with the engine OFF. 4. Measure the voltage from the vehicle speed signal circuit of the PCM to a good ground. Does the voltage measure greater than the specified value?	9.5 V	Go to Step 4	Go to Step 6
4	Test the vehicle speed signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	Repair the short to ground in the vehicle speed signal circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 8	—

DTC P0608				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 8	—
8	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0641

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The engine oil pressure (EOP) sensor
- The manifold absolute pressure (MAP) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0641 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0641 5-Volt Reference 1 Circuit

Conditions for Running the DTC

- The engine is running.
- DTC P0641 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit for more 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 number below refers to the step number on the diagnostic table.

9. A short to voltage on the signal circuit of the MAP sensor will backfeed through the sensor into the 5-volt reference circuit and set this DTC.

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/ Failure Records. Does the DTC fail this ignition?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	1. Turn OFF the ignition. 2. Disconnect the engine oil pressure (EOP) sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the EOP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 4	Go to Step 5
4	1. Connect the EOP sensor. 2. Disconnect the manifold absolute pressure (MAP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 11
5	Is the voltage measured in step 3 more than the specified value?	5.2 V	Go to Step 8	Go to Step 6

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Monitor the DMM while disconnecting the MAP sensor. Does the voltage return to within the specified range when the MAP sensor is disconnected?	4.8-5.2 V	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Test all 5-volt reference circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9
9	Test the MAP sensor signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
10	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the EOP sensor. Refer to Engine Oil Pressure Sensor and/or Switch Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 13	—

DTC P0641				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0650

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service. The control module monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the control module detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the control module detects an improper voltage on the MIL control circuit, DTC P0650 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0650 Malfunction Indicator Lamp (MIL) Control Circuit

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- DTC P0650 runs continuously when the above condition is met.

Conditions for Setting the DTC

The control module detects that the commanded state of the MIL driver and the actual state of the control circuit do not match for more than 5 seconds.

Action Taken When the DTC Sets

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

- 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 a short to ground in the MIL control circuit. With the powertrain control module (PCM) disconnected and the ignition ON, the MIL should be OFF.
6. This step tests for a short to voltage on the MIL control circuit. With the fuse removed, there should be no voltage on the MIL control circuit.

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Command the malfunction indicator lamp (MIL) ON and OFF with a scan tool. Does the MIL 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. Does the DTC fail this ignition?	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	Is the MIL always ON?	—	Go to Step 5	Go to Step 6
5	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Turn ON the ignition. Is the MIL OFF?	—	Go to Step 11	Go to Step 13

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Remove the fuse that supplies voltage to the MIL. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the MIL control circuit in the PCM harness connector to a good ground. Is the voltage less than the specified value?	1 V	Go to Step 7	Go to Step 14
7	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the MIL. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit of the PCM harness connector and a good ground. Is the MIL illuminated?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Turn ON the ignition, with the engine OFF. 4. Probe all ignition and battery positive voltage circuits of the IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate for all circuits?	—	Go to Step 9	Go to Step 12
9	Test the MIL control circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct a condition?	—	Go to Step 17	Go to Step 10

DTC P0650				
Step	Action	Value(s)	Yes	No
10	Test for an intermittent and for a poor connection at the IPC. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	Test for an intermittent and for a poor connection at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the open in the ignition voltage or battery positive voltage circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to ground in the MIL control circuit. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	—
14	Repair the short to voltage in the MIL control circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 17	—
15	Replace the IPC. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 17	—

DTC P0650				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P0651

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The air conditioning (A/C) pressure sensor.
- The fuel tank pressure (FTP) sensor, if equipped.

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore, a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0651 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0651 5-Volt Reference 2 Circuit

Conditions for Running the DTC

- The engine is running.
- DTC P0651 runs continuously when the above condition is met.

Conditions for Setting the DTC

The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit for more 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.

DTC P0651				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
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 that you observed from the Freeze Frame/ Failure Records. Does the DTC fail this ignition cycle?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	Is this vehicle equipped with a fuel tank pressure sensor?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the air conditioning (A/C) pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the A/C pressure sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 6	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the A/C pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the A/C pressure sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Step 15	Go to Step 8

DTC P0651				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Connect the A/C pressure sensor. 2. Disconnect the fuel tank pressure (FTP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the FTP sensor to a good ground with a DMM. Refer to Circuit Testing. Is the voltage within the specified range?	4.8-5.2 V	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 15
7	Is the voltage measured in the previous step more than the specified value?	5.2 V	Go to Step 11	Go to Step 9
8	Is the voltage measured in the previous step more than the specified value?	5.2 V	Go to Step 12	Go to Step 10
9	Monitor the DMM while disconnecting the FTP sensor. Does the voltage return to within the specified range when the FTP is disconnected?	4.8-5.2 V	Go to Step 14	Go to Step 10
10	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
11	Monitor the DMM while disconnecting the FTP sensor. Does the voltage return to within the specified range when the FTP sensor is disconnected?	4.8-5.2 V	Go to Step 13	Go to Step 12
12	Test all 5-volt reference circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

DTC P0651				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Test the FTP sensor signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
14	Replace the FTP sensor. Refer to Fuel Tank Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 17	—
15	Replace the A/C pressure sensor. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P0654

Circuit Description

The powertrain control module (PCM) creates the engine speed output signal by pulsing the circuit to ground at a predetermined hertz rate. The PCM pulses the circuit at the same rate as the engine speed signal input. The PCM monitors the voltage on the engine speed output circuit. If the PCM determines the voltage is out of the normal operating range, a DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0654 Engine Speed Output Circuit

Conditions for Running the DTC

- The engine speed is greater than 400 RPM.
- The ignition voltage is greater than 6 volts but less than 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 conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The history DTC clears after 40 malfunction-free warm-up cycles.
- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The PCM receives the clear code command from the scan tool.

Diagnostic Aids

IMPORTANT:

Remove any debris from the PCM connector surfaces before servicing the PCM. Inspect the PCM connector gaskets when diagnosing/replacing the PCM. Ensure that the gaskets are installed correctly. The gaskets prevent water intrusion into the PCM.

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame and/or Failure Records data can aid in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also aid determining how many ignition cycles the diagnostic reported a pass and/or a fail. Operate the vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that you observed. This will isolate when the DTC failed.

For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P0654				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Instrument Cluster Schematics Connector End View Reference: Master Electrical Component List				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check – Vehicle
2	1. Start the engine. 2. Observe the tachometer in the instrument panel cluster (IPC). Does the tachometer indicate engine RPM?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the powertrain control module (PCM) connector C2. 3. Turn the ignition ON, with the engine OFF. 4. Measure the voltage from the engine speed signal circuit to a good ground. Does the voltage measure greater than the specified value?	9.5 V	Go to Step 4	Go to Step 6
4	Test the engine speed signal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and repair the condition?	—	Go to Step 8	Go to Step 7
6	Repair the short to ground in the vehicle speed signal circuit. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 8	—
7	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 8	—

DTC P0654				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0802

Circuit Description

The transmission control module (TCM) malfunction indicator lamp (MIL) request circuit signals the powertrain control module (PCM) that the TCM is requesting MIL illumination.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0802 Transmission Control Module (TCM) MIL Request Circuit

Conditions for Running the DTC

- The ignition is ON for less than 7 seconds.
- The ignition voltage is more than 11 volts.
- DTC P0802 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM is detecting an incorrect voltage level on the TCM MIL request circuit.

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 P0802				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Connect a scan tool. Did P0802 fail this ignition?	—	Go to Step 4	Go to Step 3
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 or as close to the Freeze Frame/Failure Records data that you observed. Does the DTC fail this ignition?	—	Go to Step 4	Go to Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the transmission control module (TCM). 3. Connect a DMM from the TCM malfunction indicator lamp (MIL) request circuit at the TCM harness connector to a good ground. 4. Turn ON the ignition, with the engine OFF. Does the voltage measure near the specified value?	B+	Go to Step 5	Go to Step 6
5	Test the TCM MIL request circuit for a short to voltage. Repair as necessary. Refer to Circuit Testing and Wiring Repairs. Did you find and correct a condition?	—	Go to Step 12	Go to Step 7

DTC P0802				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test the TCM MIL request circuit for an open. Repair as necessary. Refer to Circuit Testing and Wiring Repairs. Did you find and correct a condition?	—	Go to Step 12	Go to Step 7
7	1. Leave the TCM disconnected. 2. Connect a fused jumper wire from the TCM MIL request circuit in the TCM harness connector to a good ground. 3. Clear the DTCs with a scan tool. Does DTC P0700 set, not setting P0802?	—	Go to Step 8	Go to Step 10
8	Test the TCM connectors for a bad connection. Refer to Circuit Testing and Connector Repairs. Did you find and correct a condition?	—	Go to Step 12	Go to Step 9
9	Replace the TCM. Refer to Transmission Control Module Replacement. Did you complete the replacement?	—	Go to Step 12	—
10	Test the powertrain control module (PCM) connectors for a bad connection. Refer to Circuit Testing and Connector Repairs. Did you find and correct a condition?	—	Go to Step 12	Go to Step 11
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—

DTC P0802				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 in the DTC as specified in the supporting text. Does the DTC run and pass?	—	Go to Step 13	Go to Step 2
13	Observe the stored information, Capture Info with a scan tool. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P1125

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors within one housing. Two separate signal circuits are used to connect the accelerator pedal sensor assembly and the throttle actuator control (TAC) module.

If only one APP sensor DTC is set, the redundant APP systems allow the TAC system to continue operating normally. This DTC sets if the powertrain control module (PCM) detects a condition with more than one APP sensor. One APP sensor DTC will not cause the Reduced Engine Power message to be displayed. Two APP sensor DTCs for the same sensor also will not cause the Reduced Engine Power message to be displayed. However, if two or more DTCs are set involving more than one APP sensor, this DTC will set and the Reduced Engine Power message is displayed.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1125 Accelerator Pedal Position (APP) System

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is greater than 5.23 volts.
- DTC P1125 runs continuously when the above conditions are met.

Conditions for Setting the DTC

- Two or more APP sensors are out of range. OR
- The APP sensors disagree.
- The above condition is 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. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- The APP sensor 1 and the throttle position (TP) sensor 1 5-volt reference circuits are internally connected within the TAC module.
- The APP sensor 2 and the TP sensor 2 5-volt reference circuits are internally connected within the TAC module.
- 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. Remember this if you review the information stored in Captured Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	**IMPORTANT:** *This DTC indicates that two or more accelerator pedal position (APP) sensor DTCs are also set. Diagnose the APP sensor DTCs that are set.* Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Record the throttle actuator control (TAC) module calibration with a scan tool. Does the TAC module calibration match the part number of the TAC module?	—	Go to Step 3	Go to Step 11
3	Observe the DTC Information with a scan tool. Is DTC P2120 or P2125 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the APP Sensors 1 and 2 parameter with a scan tool. Does the scan tool indicate that the APP sensors 1 and 2 parameters disagree?	—	Go to Step 5	Go to Testing for Intermittent Conditions and Poor Connections

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor. 3. Disconnect the TAC module. 4. Measure the resistance of the following circuits for each of the APP sensors with a DMM: – The low reference circuit – The signal circuit – The 5-volt reference circuit Is the resistance more than the specified value for any circuit?	5 ohms	Go to Step 9	Go to Step 6
6	Test the signal circuit of the APP sensor 1 for a short to the signal circuit of the APP sensor 2. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Test for an intermittent and for a poor connection at the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	Test for an intermittent and for a poor connection at the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	Repair the high resistance in the circuit that measured above the specified value. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 12	—

DTC P1125				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 12	—
12	1. Assemble the vehicle, as necessary. 2. Clear the DTCs with a scan tool. 3. Start the engine. 4. Operate the system in order to verify the repair. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 13
13	**IMPORTANT:** *Be aware that repairing one individual condition may correct more than one DTC.* Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P1133 or P1153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the number of rich-to-lean and lean-to-rich transitions. If the PCM detects that the number of transitions were less than a specified value, DTC P1133 sets for HO2S bank 1 sensor 1, or DTC P1153 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1133 HO2S Insufficient Switching Bank 1 Sensor 1
- DTC P1153 HO2S Insufficient Switching Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.

- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the affected HO2S lean-to-rich or rich-to-lean transitions are less than a calibrated value for a 100 second monitoring period.

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 the voltage is varying above and below the specified value, the condition is not present.

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step 7
6	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
7	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 10	Go to Step 9

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the HO2S low signal circuit for an open, or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* • A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant. Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 14	—

DTC P1133 or P1153				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P1134 or P1154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from above 625 mV to below 250 mV or from below 250 mV to above 625 mV. If the PCM detects that the difference between the rich-to-lean average transition time and lean-to-rich average transition time is more than a specified value, DTC P1134 sets for HO2S bank 1 sensor 1, or DTC P1154 sets for HO2S bank 2 sensor 1.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1134 HO2S Transition Time Ratio Bank 1 Sensor 1
- DTC P1154 HO2S Transition Time Ratio Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0128, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- he Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- This diagnostic runs one time per drive cycle once the above conditions are met.

Conditions for Setting the DTC

The PCM detects that the difference between the HO2S rich-to-lean average transition time and the lean-to-rich average transition time is more than a calibrated value for a 100 second monitoring period.

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 the voltage is varying above and below the specified value, the condition is not present.

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
6	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 8	Go to Step
7	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* **IMPORTANT:** *The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:* • A silicon contaminated HO2S • Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Engine oil consumption--Refer to Oil Consumption Diagnosis. • Engine coolant consumption--Refer to Loss of Coolant Replace the affected HO2S. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1. Did you complete the replacement?	—	Go to Step 12	—

DTC P1134 or P1154				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P1258

Circuit Description

The powertrain control module (PCM) uses the ECT sensor to monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 132°C (270°F). When an over temperature condition is present, DTC P1258 will set. The PCM will disable two groups of four cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the PCM is able to reduce the temperature of the coolant.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1258 Engine Coolant Overtemperature - Protection mode Active

Conditions for Running the DTC

1. DTCs P0117, P0118, P1114, and P1115 are not active.
2. The engine is running.

Conditions for Setting the DTC

The engine coolant temperature is above 132°C (270°F) for 10 seconds or more.

Action Taken When the DTC Sets

1. The PCM will illuminate the malfunction indicator Lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
2. The PCM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
3. The PCM will alternately disable two groups of four cylinders by turning OFF the fuel injectors.
4. The PCM will store conditions which were present when the DTC set as Freeze Frame and File Records data.

Conditions for Clearing the MIL/DTC

1. The PCM will turn the MIL OFF after 3 consecutive trips that the diagnostic has been run and passed.
2. The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
3. The DTC can be cleared by using the scan tool Clear DTC Information function.

DTC P1258			
Step	**Action**	**Yes**	**No**
Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check – Vehicle in Vehicle DTC Information
2	Check the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to Engine Overheating	Go to Symptoms - Engine Cooling

DTC P1380

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the antilock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set with the malfunction indicator lamp (MIL) illuminated, and the rough road information is not available due to an ABS malfunction, DTC P1380 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1380 Misfire Detected - Rough Road Data Not Available

Conditions for Running the DTC

- The vehicle speed is more than 8 km/h (5 mph).
- The engine load is less than 60 percent.
- The engine misfire is detected and DTC P0300 is set with the MIL illuminated.
- The engine speed is less than 7,000 RPM.
- DTC P1380 runs continuously when the above conditions are met.

Conditions for Setting the DTC

An ABS malfunction exists for more than 45 seconds, preventing the PCM from receiving rough road detection data.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory 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 Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

DTC P1380				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Does the scan tool display any antilock brake system (ABS) DTCs?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Symptoms - Antilock Brake System

DTC P1381

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the antilock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set with the malfunction indicator lamp (MIL) illuminated, and there is no communication with the brake control module, DTC P1381 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1381 Misfire Detected - No Communication with Brake Control Module

Conditions for Running the DTC

- The vehicle speed is above 8 km/h (5 mph).
- The engine speed is below 7,000 RPM.
- The engine load is less than 60 percent.
- Engine misfire is detected and DTC P0300 is set with the MIL illuminated.
- DTC P1381 runs continuously when the above conditions are met.

Conditions for Setting the DTC

The PCM cannot communicate with the brake control module for more than 45 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory 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 Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

DTC P1381				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Does the scan tool display any antilock brake system (ABS) DTCs?		Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Symptoms - Antilock Brake System

DTC P1516

Circuit Description

The predicted throttle position (TP) is compared to the actual throttle position. The two values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the predicted and actual throttle position. This DTC sets if the PCM detects an out of range condition between the predicted and actual throttle position.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1516 Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance

Conditions for Running the DTC

- DTC U0107 is not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- The TAC System is not in the battery saver mode.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The TAC module detects that the predicted and the actual throttle positions are not within a calibrated range of each other.
- The PCM and the TAC cannot determine the throttle position.
- Both of the TP sensors are invalid.
- All of the above conditions are met for more 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. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- 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 an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

7. If the TP indicated angle does not follow the movement of the throttle blade and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.
18. Locating and repairing an individual condition may correct more than one DTC.

DTC P1516				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 set?	—	Go to DTC U0107	Go to Step 3
3	Is DTC P2135 set?	—	Go to DTC P2135	Go to Step 4
4	**IMPORTANT:** *Low system voltage may cause this DTC to set. Clear DTCs if low system voltage has been experienced.* 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Throttle Position (TP) Sensor 1 and TP Sensor 2 Angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return it to the released position. Does the scan tool indicate both Angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is released?	—	Go to Diagnostic Aids	Go to Step 5

DTC P1516				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body. 4. Inspect the throttle body and throttle plate for the following conditions which may cause the throttle plate to bind: - Debris--If debris is found, clean the throttle body and repair the source of contamination. - Damage or evidence of tampering--If the throttle body and/or throttle plate is damaged, replace the throttle body. Refer to Throttle Body Assembly Replacement. Did you find and correct the condition?	—	Go to Step 17	Go to Step 6
6	With your hand, slowly open the throttle plate to WOT and back to the closed position several times. Does the throttle plate move smoothly without binding in both directions?	—	Go to Step 7	Go to Step 14
7	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 4. Turn ON the ignition, with the engine OFF. 5. Open the throttle blade to WOT, then to the closed position by hand. 6. Observe the TP Sensor 1 and TP Sensor 2 Angle parameters with a scan tool. Does the scan tool indicate both Angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the plate is moved to the closed position?	—	Go to Step 8	Go to Step 15

DTC P1516				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the throttle actuator control motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 9
9	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	Test each TAC motor circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
11	1. Disconnect the other TAC module harness connector. 2. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 17	Go to Step 12
12	1. Turn OFF the ignition. 2. Connect the TAC module. 3. Connect a test lamp between the two TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	—	Go to Step 13	Go to Step 15

DTC P1516				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Inspect for poor connections at the TAC motor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
14	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	Inspect for poor connections at the TAC module harness connectors. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
16	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 17	—

DTC P1516				
Step	**Action**	**Value(s)**	**Yes**	**No**
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 - Vehicle	System OK

DTC P2101

Circuit Description

The commanded throttle position (TP), based on accelerator pedal position (APP) and possibly other limiting factors, is compared to the actual TP. The 2 values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the commanded and actual TP. This DTC sets if the PCM detects an out-of-range condition between commanded and actual pedal position.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2101 Control Module Throttle Actuator Position Performance

Conditions for Running the DTC

- DTCs P0601, P0602, P0604, P0606, P1516, P2108, U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 8.5 volts.
- The TAC System is not in the battery saver mode.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the commanded and actual throttle positions are not within a calibrated range of each other.
- The above condition is met 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 for mechanical concerns or binding that may be temperature related. Components may not move freely in extreme heat or cold due to the presence of contaminants or ice formation.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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 an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. If the TP indicated angle does not follow the movement of the throttle blade, and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.
15. Locating and repairing an individual condition may correct more than one DTC.

DTC P2101				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 also set?	—	Go to DTC U0107	Go to Step 3
3	**IMPORTANT:** **The next test must be started within 15 seconds after the ignition is turned ON.** 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Throttle Position (TP) Sensor 1 and TP Sensor 2 Angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return the pedal to the released position. Does the scan tool indicate both Angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is moved to the released position?	—	Go to Diagnostic Aids	Go to Step 4

DTC P2101				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 5. Turn ON the ignition with the engine OFF. 6. Open the throttle blade to WOT and then to the closed position by hand. 7. Observe the TP Sensor 1 and TP Sensor 2 Angle parameters with a scan tool. Does the scan tool indicate both Angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the throttle plate is moved to the closed position?	—	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TAC motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 6
6	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	Test each TAC motor circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8

DTC P2101				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	1. Disconnect the other TAC module harness connector. 2. Remove all jumper wires. 3. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Connect the TAC module. 3. Connect a test lamp between the two TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	—	Go to Step 10	Go to Step 12
10	Inspect for poor connections at the TAC motor harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 14	—
12	Inspect for poor connections at the TAC module harness connectors. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

DTC P2101				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. 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 - Vehicle	System OK

DTC P2108

Circuit Description

The throttle actuator control (TAC) module contains data which is essential for proper TAC System operation. The TAC module continuously tests the integrity of this data. When the TAC module is unable to write or read data to and from random access memory (RAM), or the TAC module is unable to correctly read data from the flash memory or an internal TAC module processor fault is detected, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2108 Throttle Actuator Control (TAC) Module Performance

Conditions for Running the DTC

- DTC U0107 is not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is greater than 6 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The TAC module determines that an internal data test did not pass.
- The above condition is met for more 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

- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing an individual condition may correct more than 1 DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

Test Description

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

4. Locating and repairing an individual condition may correct more than 1 DTC.

DTC P2108				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Replace the throttle actuator control (TAC) module. Refer to Throttle Actuator Control Module Replacement. Did you complete the replacement?	—	Go to Step 3	—
3	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 4
4	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2120

Circuit Description

The accelerator pedal position (APP) sensor 1 is a potentiometer type sensor with the following three circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 signal or APP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2120 Accelerator Pedal Position (APP) Sensor 1 Circuit

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, or U0107 are not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The APP sensor 1 voltage is less than 0.24 volts or more than 4.49 volts. OR
- The 5-volt reference is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:

- The control module commands Reduced Engine Power mode.
- The APP indicated angle is limited to a predetermined value to limit the amount of throttle control. OR
- The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
- The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

4. This test isolates whether the short is to another TAC System circuit in the harness or within the TAC module.
15. When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTC P0120 or U0107 is also set, refer to the appropriate DTC for further diagnosis.* 1. Turn ON the ignition with the engine OFF, and with your foot OFF the accelerator pedal. 2. Observe the accelerator pedal position (APP) sensor 1 voltage with a scan tool. Does the scan tool indicate the APP sensor 1 voltage is within the specified values?	0.24-2.24 V	Go to Step 3	Go to Step 6
3	Depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate APP sensor 1 voltage within the specified values?	0.24-4.49 V	Go to Step 4	Go to Step 6
4	1.Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Select the diagnostic trouble code (DTC) option using the scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors while monitoring the DTC information. Did this DTC fail this ignition during the above test?	—	Go to Step 24	Go to Step 5

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Continue to observe the DTC Information. 2. Depress the accelerator pedal to WOT, then return the pedal to the rest position. Did this DTC fail this ignition during the above test?	—	Go to Step 19	Go to Diagnostic Aids
6	Disconnect the APP sensor harness connector. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	0 V	Go to Step 7	Go to Step 11
7	Connect a test lamp between the APP sensor 1 signal circuit and B+. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	5 V	Go to Step 8	Go to Step 13
8	Test the APP sensor 1, 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to Step 10	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body assembly. 4. Turn ON the ignition, with the engine OFF. 5. Rotate the throttle blade by hand to WOT and hold. 6. Test the APP sensor 1, 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21	Go to Step 21	Go to Step 16

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Connect a fused jumper between the APP sensor 1 low-reference circuit and the APP sensor 1, 5-volt reference circuit. 2. Observe the Throttle Position (TP) Sensor 1 Voltage parameter with a scan tool. 3. Does the scan tool indicate TP sensor 1 voltage at the specified value?	0 V	Go to Step 19	Go to Step 17
11	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the APP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the APP sensor 1 signal circuit for a short to voltage with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 12
12	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 25	Go to Step 14

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Test the APP sensor 1 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 15
15	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
16	1. Turn OFF the ignition. 2. Disconnect the TAC module connector containing the APP sensor circuits. 3. Test the APP sensor 1, 5-volt reference circuit for the following conditions with a DMM: – An open – A short to ground – High resistance Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
17	1. Disconnect the TAC module connector containing the APP sensor circuits. 2. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 18

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
18	Test the TAC module ground circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
19	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20
20	Replace the APP sensor assembly. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the repair?	—	Go to Step 25	—
21	Did DTC P0120 set while performing Step 9?	—	Go to DTC P0120	Go to Step 22
22	Inspect for poor connections at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
23	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 25	—
24	Repair the intermittent condition as necessary. Refer to Connector Repairs and Wiring Repairs. Did you complete the repair?	—	Go to Step 25	—

DTC P2120				
Step	**Action**	**Value(s)**	**Yes**	**No**
25	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 26
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2121

Circuit Description

The accelerator pedal position (APP) sensor 1 and APP sensor 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensors a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module signal voltages proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is also low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 signal and the APP sensor 2 signal circuits are out of correlation, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2121 Accelerator Pedal Position (APP) Sensor 1 Performance

Conditions for Running the DTC

- DTCs P0606, P2108, or U0107 are not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- APP sensor 1 disagrees with APP sensor 2 by more than 10.5 percent.
- The above condition is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set for a single APP sensor, the following occurs:

- The control module commands Reduced Engine Power mode.
- The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.
- The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
- The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. This step determines if a communication condition exists.
5. This step isolates an internal APP sensor failure. The condition may only occur at a certain accelerator pedal position. Monitoring the APP angles for sensor 2 and sensor 3 is an accurate way of verifying the actual position of the pedal. The APP angles for all 3 sensors should be within a few percent of each other. If the pedal is at rest, the APP angle for all 3 sensors should be 0 percent. If the pedal is fully depressed, all APP angles should be 100 percent.
6. The APP sensor 1 shares a common 5-volt reference circuit with the throttle position (TP) sensor 1. Monitoring the TP sensor 1 voltage aids in diagnosing the APP sensor 5-volt reference and low-reference circuits. If the scan tool displays near 0 volts, the circuits are OK.
9. With the TAC module still connected, this test will help determine a short to the signal circuit either within the TAC module or wiring.
10. This step determines whether the TAC module or a shorted circuit is causing the condition.
19. 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. Remember this if you review the stored information in Capture Info.

DTC P2121				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 also set?	—	Go to DTC U0107	Go to DTC U0107
3	**IMPORTANT:** **Do not depress the accelerator pedal.** 1. Start the engine. 2. Observe the diagnostic trouble code (DTC) information with a scan tool. Did any other throttle actuator control (TAC) module or accelerator pedal position (APP) sensor DTC set except P1125?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	Observe the APP Sensor Agree/Disagree parameters with a scan tool. Does the scan tool indicate Disagree for any of the APP Agree/Disagree parameters?	—	Go to Step 6	Go to Step 5
5	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP sensor angles for both APP sensors with a scan tool. 3. Slowly depress the accelerator pedal, stopping at 25, 50, 75, and 100 percent. 4. Slowly release the accelerator pedal, stopping at 75, 50, 25, and 0 percent. Does the scan tool indicate APP sensor 1 angle within 10.5 percent of the APP sensor 2 angle during the above test?	—	Go to Diagnostic Aids	Go to Step 6

DTC P2121

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a fused jumper between the APP sensor 1, 5-volt reference circuit and ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Throttle Position (TP) Sensor 1 Voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage at the specified value?	0.0 V	Go to Step 7	Go to Step 11
7	1. Connect a fused jumper between the APP sensor 1, 5-volt reference circuit and the APP sensor 1 low-reference circuit. 2. Observe the TP Sensor 1 Voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage at specified value?	0.0 V	Go to Step 8	Go to Step 12
8	1. Connect a fused jumper between the APP sensor 1 signal circuit and the APP sensor 1, 5-volt reference circuit. 2. Observe the APP Sensor 1 Voltage parameter with a scan tool. Does the scan tool indicate APP sensor 1 voltage near the specified value?	5.0 V	Go to Step 14	Go to Step 9
9	Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a DMM. Does the DMM indicate a short to another circuit?	—	Go to Step 10	Go to Step 13

DTC P2121				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	1. Turn OFF the ignition. 2. Disconnect both of the TAC module harness connectors. 3. Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
11	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1, 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
12	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs Did you find an open or high resistance?	—	Go to Step 18	Go to Step 15

DTC P2121				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	Inspect for poor connections at the harness connectors of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Replace the APP sensor assembly. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 18	—
17	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. 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. Did 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 - Vehicle	System OK

DTC P2125

Circuit Description

The accelerator pedal position (APP) sensor 2 is a potentiometer type sensor with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 2 signal or the APP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2125 Accelerator Pedal Position (APP) Sensor 2 Circuit

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, U0107 are not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The APP sensor 2 voltage is less than 0.24 volt or more than 4.49 volts. OR
- The 5-volt reference is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:

- The control module commands Reduced Engine Power mode.
- The APP indicated angle is limited to a predetermined value to limit the amount of throttle control. OR
- The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
- The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. The throttle position (TP) sensor 2 and the APP sensor 2 share a common 5-volt reference source. Diagnose DTC P0220 first if P0220 is also set.
18. This test determines whether or not the TAC module can recognize a change in signal voltage.
19. There are 2 separate 5-volt reference sources within the TAC module. The TP sensor 1 and the APP sensor 1 share one 5-volt reference source. The TP sensor 2 and the APP sensor 2 share another common 5-volt reference source. This test determines whether the signal circuit is shorted to any one of the 5-volt reference circuits. If a short exists, the corresponding sensor voltage will be pulled low.
20. The previous step found the signal circuit and a 5-volt reference circuit shorted together. This test isolates whether the short is in the harness or within the TAC module.
26. When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *If DTC P0220 or U0107 is also set, refer to Diagnostic Trouble Code (DTC) List - Vehicle and diagnose the applicable DTC first.* 1. Turn ON the ignition, with the engine OFF, and with your foot OFF of the accelerator pedal. 2. Observe the Accelerator Pedal Position (APP) Sensor 2 Voltage parameter with a scan tool. Does the scan tool indicate APP sensor 2 voltage within the specified values?	0.24-2.24 V	Go to Step 3	Go to Step 6
3	Fully depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate APP sensor 2 voltage within the specified values?	0.24-4.49 V	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe DTC info with a scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors for the APP sensor while observing the DTC status. 5. If the scan tool indicates this DTC failed this ignition during the above test, repair the intermittent condition as necessary. Refer to Wiring Repairs and Connector Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 5

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Slowly depress the accelerator pedal to WOT, then slowly return the pedal to closed throttle while observing the DTC status. Did the scan tool indicate this DTC failed this ignition during the above test?	—	Go to Step 21	Go to Diagnostic Aids
6	1. Disconnect the APP sensor harness connector. 2. Test the APP sensor 2 signal circuit for voltage with a DMM. Does the DMM indicate APP sensor 2 signal voltage within the specified values?	3.94-6.06 V	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the APP sensor circuits. 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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 8
8	Test the APP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 9
9	Test the APP sensor 2 signal circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 10

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
10	Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
11	Test the APP sensor 2, 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to Step 16	Go to Step 12
12	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 13
13	Test the APP sensor 2, 5-volt reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 14
14	Test the APP sensor 2, 5-volt reference circuit for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 15
15	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. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Measure resistance with a DMM connected between the APP sensor 2 low reference circuit and the APP sensor 1 low reference circuit. Does the DMM indicate resistance within the specified values?	0-5 ohms	Go to Step 18	Go to Step 17
17	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 2 low reference circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
18	1. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. 2. Observe the APP Sensor 2 Voltage parameter with a scan tool. Does the scan tool indicate APP sensor 2 voltage at the specified value?	0 V	Go to Step 19	Go to Step 23
19	1. Observe the APP Sensor 1, APP Sensor 3 and TP Sensor 2 Voltage parameters with a scan tool. 2. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. Did the scan tool indicate a change in voltage in any of the parameters observed during the above test?	—	Go to Step 20	Go to Step 21

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connectors. 3. Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
21	Inspect for poor connections at the harness connector of the APP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
22	Replace the APP sensor assembly. Refer to Accelerator Pedal Position (APP) Sensor Replacement. Did you complete the replacement?	—	Go to Step 25	—
23	Inspect for poor connections at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
24	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 25	—

DTC P2125				
Step	**Action**	**Value(s)**	**Yes**	**No**
25	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 26
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2135

Circuit Description

The throttle position (TP) sensors 1 and 2 are potentiometer type sensors each with three circuits:
- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensors are used to determine the throttle plate angle for various engine management systems. The control module provides each TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensors then provide the control module with signal voltage proportional to throttle plate movement. Both TP sensor signal voltages are low at closed throttle and increase as the throttle opens. When the control module detects that TP sensor 1 signal and TP sensor 2 signals disagree or signal voltages are outside the predetermined range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:
- DTC P2135 Throttle Position (TP) Sensor 1-2 Correlation

Conditions for Running the DTC

- DTCs P2108, or U0107 not set.
- The ignition switch is in the crank or run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 2 disagrees with the TP sensor 1 by more than 7.5 percent.
- The above condition is present for more 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 throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.
- If this DTC is determined to be intermittent, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

21. When the TAC module detects a condition within the TAC System, more than 1 TAC System related DTC may set. This is due to the many redundant tests 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. Remember this if you review the stored information in Capture Info.

DTC P2135				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Is DTC U0107 set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Throttle Position (TP) Sensor 1 and 2 Agree/ Disagree parameter with a scan tool. Does the scan tool TP Sensor 1 and 2 Agree/Disagree parameter indicate Disagree?	—	Go to Step 5	Go to Step 4
4	1. Remove the air inlet duct from the throttle body. 2. Disconnect the throttle body harness connector. 3. Observe the TP sensor 1 and 2 with a scan tool. 4. Slowly open the throttle blade to wide open throttle (WOT) and back to the closed throttle position several times by hand. Does the TP Sensor Agree/Disagree parameter change from Agree to Disagree during the above test?	—	Go to Step 18	Go to Step 20
5	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connectors. 3. Test the TP sensor 1, 5-volt reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 6

DTC P2135				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Test for a short between the TP sensor 1, 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 7
7	Test the TP sensor 1 signal circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 8
8	Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
9	Test the TP sensor 1 low-reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 10
10	Test for a short between the TP sensor 1 low-reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 11
11	Test the TP sensor 2, 5-volt reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 12
12	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. Did you find and correct the condition?	—	Go to Step 20	Go to Step 13

DTC P2135				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Test the TP sensor 2 signal circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 14
14	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. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
15	Test the TP sensor 2 low-reference circuit for resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
16	Test for a short between the TP sensor 2 low-reference circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
17	Inspect for an intermittent and for a poor connection at the harness connector of the TAC module. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
18	Inspect for an intermittent and for a poor connection at the harness connector of the throttle body. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

DTC P2135				
Step	Action	Value(s)	Yes	No
19	Replace the throttle body assembly. Refer to Throttle Body Assembly Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	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 21
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2138

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the powertrain control module (PCM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is near the low reference and increases as the pedal is actuated.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2138 Accelerator Pedal Position (APP) Sensor 1-2 Correlation

Conditions for Running the DTC

- The battery voltage is more than 5.23 volts.
- DTCs P2120 or P2125 are not set.
- The accelerator pedal is leaving the idle position.
- DTC P2138 runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value.
- The above condition is met for more than 2 seconds.

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 PCM turns OFF the MIL after 3 consecutive drive trips that the diagnostic runs and does not fail.
- A History DTC clears after 40 consecutive warm up cycles in which no failures are reported by this diagnostic or any other emission related diagnostic.
- The scan tool clears the MIL/DTC.

Diagnostic Aids

- The PCM compares the signal of each of the accelerator pedal position sensor to each other throughout the entire range of operation. Clear the DTCs and actuate the pedal through the entire range with the ignition ON and the engine OFF.
- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector. Using this kit will prevent damage to the harness connector terminals.
- For intermittent conditions, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. Any circuit faults on either APP sensor 1 or 2 will set one of the DTCs listed. Refer to the appropriate table for diagnosis.

DTC P2138				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the DTC information with a scan tool. Is DTC P0120, P0220, P0641, P0651, P2120, or P2125 also set?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor electrical connector. 3. Disconnect the powertrain control module (PCM). 4. Use a DMM to measure the resistance of the following circuits for each of the APP sensors: – The low reference circuit – The signal circuit – The 5-volt reference circuit Did any of the circuits measure more than the specified value?	5 ohms	Go to Step 5	Go to Step 4
4	1. Test for a short between any of the circuits in the APP sensor harness. 2. Repair the circuit as necessary. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair the high resistance in the circuit. Refer to Wiring Repairs Did you complete the repair?	—	Go to Step 7	—

DTC P2138				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Replace the APP sensor. Refer to Accelerator Pedal with Position Sensor Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	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 - Vehicle	System OK

DTC P2636

Circuit Description

The secondary fuel pump is located in the rear fuel tank. The secondary fuel pump is powered by a secondary fuel pump relay. Fuel is transferred from the rear fuel tank to the front fuel tank in order to ensure all of the usable fuel volume is available to the primary fuel pump. The secondary fuel pump relay supply voltage is received from the primary fuel pump relay when the primary fuel pump is energized. This DTC sets when the powertrain control module (PCM) commands the secondary fuel pump ON and a predetermined change in both the front and rear fuel level sensors does not occur.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P2636 Fuel Transfer Pump Flow Insufficient

Conditions for Running the DTC

- DTCs P0461, P0462, P0463, P2066, P2067, P2068 are not set.
- The vehicle speed is 0 km/h (0 mph).
- The engine has been idling for more than 2 minutes and 20 seconds.
- The primary fuel level is less than 60 L (15.8 gal).
- The secondary fuel level is more than 3 L (2.6 gal).

Conditions for Setting the DTC

The PCM does not detect a change of 4 L (1.06 gal), in both the primary and the secondary fuel level sensors, with the secondary pump commanded ON for 120 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

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 non-emission related diagnostic.

Clear the DTC with a scan tool.

Test Description

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

2. This step tests the supply voltage circuit of the secondary fuel pump relay. The test lamp should illuminate as the primary fuel pump is commanded ON.
4. This step verifies the secondary fuel pump operation. Listen for an audible sound as the secondary fuel pump relay harness connector is jumpered.
5. This step verifies that there is adequate fuel in the rear fuel tank. The rear fuel tank sensor voltage must be above 1 volt in order to continue.
7. This step tests the secondary fuel pumps ability to transfer fuel. The rear fuel level sensor voltage should decrease while the secondary fuel pump is ON.
8. This step tests for a short to ground on the control circuit of the secondary fuel pump relay. If the test lamp illuminates, a short to ground is indicated.
9. This step tests for a short to voltage on the control circuit of the secondary fuel pump relay. If the test lamp illuminates, a short to voltage is indicated.

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** **The fuel level must be between 25-50 percent to perform this diagnostic procedure. If the fuel level is not within this range, misdiagnosis will occur.** 1. Turn OFF the ignition. 2. Remove the secondary fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the secondary fuel pump relay coil supply circuit with a test lamp connectd to a good ground. 5. Command the fuel pump relay ON with a scan tool. Does the test lamp illuminate when the fuel pump relay is commanded ON?	—	Go to Step 3	Go to Step 22
3	Probe the ignition voltage circuit of the secondary fuel pump relay, switch side, with a test lamp connected to a good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 12
4	Connect a 15-amp fused jumper wire between the ignition 1 voltage and secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. Does the secondary fuel pump turn ON?	—	Go to Step 5	Go to Step 16

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Turn OFF the ignition. 2. Remove the jumper wire from the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the rear fuel level voltage parameter with a scan tool. Is the rear fuel level sensor voltage above the specified value?	1V	Go to Step 7	Go to Step 6
6	1. Add the specified amount of fuel to the fuel tank. Did you complete the action?	19 L (5 gal)	Go to Step 7	—
7	1. Turn OFF the ignition. 2. Connect a 15-amp fused jumper wire between the ignition 1 voltage circuit and the secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the rear fuel level sensor voltage parameter with a scan tool. Does the rear fuel level sensor voltage decrease as the secondary fuel pump is operating?	—	Go to Step 8	Go to Step 18
8	1. Turn OFF the ignition. 2. Remove the jumper wire from the secondary fuel pump relay harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Probe the secondary fuel pump relay control circuit with a test lamp connected to B+. Does the test lamp illuminate?	—	Go to Step 23	Go to Step 9

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Probe the secondary fuel pump relay control circuit with a test lamp connected to a good ground. Does the test lamp illuminate?	—	Go to Step 27	Go to Step 10
10	Test the secondary fuel pump relay control circuit for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 21
11	Test the secondary fuel pump relay control circuit for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 21
12	Inspect the PCM 1 fuse. Is the PCM 1 fuse open?	—	Go to Step 13	Go to Step 25
13	Test the ignition 1 voltage circuit of the secondary fuel pump relay for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 14
14	Test the voltage supply circuit of the secondary fuel pump for a short to ground. Refer to Circuit Testing and Wiring Repairs Did you find and correct the condition?	—	Go to Step 31	Go to Step 15

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	1. Turn OFF the ignition. 2. Install a new fuse. 3. Connect a 15-amp fused jumper wire between the ignition 1 voltage and the secondary fuel pump supply voltage circuit of the secondary fuel pump relay harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Inspect the PCM 1 fuse. Is the fuse open?	—	Go to Step 29	Go to Testing for Intermittent Conditions and Poor Connections
16	1. Lower the rear fuel tank. 2. Disconnect the secondary fuel pump harness connector. 3. Probe the voltage supply circuit of the secondary fuel pump with a test lamp connected to a good ground. Does the test lamp illuminate?	—	Go to Step 17	Go to Step 26
17	Probe the ground circuit of the secondary fuel pump with a test lamp connected to B+. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 24
18	Inspect the fuel line between the primary and secondary fuel tanks for a restriction. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29
19	Test for an intermittent and for a poor connection at the harness connector of the secondary fuel pump relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 28

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
20	Test for an intermittent and for a poor connection at the harness connector of the secondary fuel pump. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29
21	Test for an intermittent and for a poor connection at the harness connector of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 31	Go to Step 30
22	Repair the open supply voltage circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
23	Repair the short to ground in the control circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
24	Repair the open ground circuit of the secondary fuel pump. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
25	Repair the open ignition voltage circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
26	Repair the open supply voltage circuit of the secondary fuel pump. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—

DTC P2636				
Step	**Action**	**Value(s)**	**Yes**	**No**
27	Repair the short to voltage on the control circuit of the secondary fuel pump relay. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 31	—
28	Replace the secondary fuel pump relay. Did you complete the replacement?	—	Go to Step 31	—
29	Replace the rear fuel sender assembly. Refer to Fuel Sender Assembly Replacement. Did you complete the replacement?	—	Go to Step 31	—
30	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 31	—
31	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 32
32	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC P2A01 or P2A04

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream.

The HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 are used for catalyst monitoring. This diagnostic runs once per ignition cycle. This diagnostic consists of two tests, a passive test and an intrusive test. During the passive test, if the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 voltage transitions below 349 mV and above 710 mV, the DTC will pass for this ignition cycle. If the DTC does not pass during the passive test, the intrusive test will begin. During the intrusive test, the control module will force the air-to-fuel ratio rich and/or lean. The control module then waits for a predicted response from the HO2S. If the HO2S voltage transitions below 349 mV and/or above 710 mV, the DTC will pass for this ignition cycle. If the control module does not receive the expected response from the HO2S, DTC P2A01 will set for HO2S bank 1 sensor 2 or DTC P2A04 will set for HO2S bank 2 sensor 2.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2A01 HO2S Circuit Bank 1 Sensor 2
- DTC P2A04 HO2S Circuit Bank 2 Sensor 2

Conditions for Running the DTC

DTCs P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0125, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1134, P1153, P1154 are not set.

Passive Test

- The engine is running.
- The engine run time is more than 2 seconds.
- This diagnostic runs one time per drive cycle when the above conditions are met.

Intrusive Test

- The engine run time is more than 218 seconds.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Engine Speed parameter is between 900-5,000 RPM.
- The MAF Sensor parameter is between 5-100 g/s.
- The Vehicle Speed parameter is between 24-131 km/h (15-82 mph).
- The Short Term FT Bank 1 and Bank 2 parameter is between -4 and +4 percent.
- The maximum number of intrusive attempts is less than 100.
- This diagnostic runs one time per drive cycle when the above conditions are met for 3 seconds.

Conditions for Setting the DTC

The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 did not transition below 349 mV and above 710 mV during the passive test.

One of the following tests fail:

- Lean Intrusive Test
  - — The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is more than 349 mV for 60 seconds.
  - — The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is less than 300 mV. OR
- Rich Intrusive Test
  - — The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is less than 710 mV for 60 seconds.
  - — The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is more than 600 mV.

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 the voltage does not change more than the specified value, the condition is present.

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to Scan Tool Data List. 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to Step 3	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 Testing for Intermittent Conditions and Poor Connections
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 6	Go to Step 5

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800mV	Go to Step 7	Go to Step 8
6	Test the HO2S high signal circuit for a short to ground. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
7	**IMPORTANT:** *The sensor may be damaged if the circuit is shorted to a voltage source.* Test the HO2S high signal circuit for a short to voltage. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to Circuit Testing. Is the voltage more than the specified value?	2V	Go to Step 10	Go to Step 11

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
10	Test the HO2S low signal circuit for a short to voltage. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 12	Go to Step 14
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to Step 15	Go to Step 13

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Test the HO2S low signal circuit for an open or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
14	Test the HO2S high signal circuit for an open or high resistance. Refer to the following procedures: • Circuit Testing • Wiring Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
15	The HO2S may be detecting a rich exhaust condition, a lean exhaust condition, or the HO2S may be contaminated. Inspect for the following conditions: **NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* A silicon contaminated HO2S – Any water intrusion into the HO2S connector – An exhaust leak between the HO2S and the engine – Any vacuum leaks – Engine oil contaminated with fuel – An incorrect fuel pressure--Refer to Fuel System Diagnosis. – Any lean or rich fuel injectors--Refer to Alcohol/ Contaminants-in-Fuel Diagnosis. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
16	Test for shorted terminals and for poor connections at the HO2S. Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

DTC P2A01 or P2A04				
Step	**Action**	**Value(s)**	**Yes**	**No**
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to the following procedures: • Testing for Intermittent Conditions and Poor Connections • Connector Repairs • Heated Oxygen Sensor (HO2S) Wiring Repairs Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the affected HO2S. 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 20	—
19	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 20	—
20	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 21
21	1. Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DTC U0107

Circuit Description

The throttle actuator control (TAC) module and the powertrain control module (PCM) communicate via a dedicated serial data circuit. This serial data circuit is separate from any other serial data circuit on the vehicle. Accurate transmitting and receiving of serial data requires not only good circuit integrity, but also adequate system voltage. This diagnostic test monitors the accuracy of the serial data transmitted between the TAC module and the PCM. If the PCM detects a loss of data or invalid data, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC U0107 Lost Communication with Throttle Actuator Control (TAC) Module

Conditions for Running the DTC

- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- This diagnostic runs continuously when the above conditions are met.

Conditions for Setting the DTC

- Invalid or missing serial data messages are detected for a predetermined amount of time.
- The above condition is met for more 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

IMPORTANT:
Reprogramming the PCM may cause a communication error between the PCM and the TAC. If the PCM detects a communication error, DTC U0107 sets. Clear any DTCs from the memory that may have been set by Reprogramming.

- DTC U0107 sets if the battery voltage is low. If the customer's concern is slow cranking or no crank because battery voltage is low, ignore DTC U0107. Clear any DTCs from memory that may have set from the low battery voltage condition.
- DTC U0107 sets when there is a short to B+ on the TAC module ground circuit. Inspect the fuses for the circuits that are in the TAC module harness--i.e. cruise, brake. An inspection of the fuses may lead you to the circuit that is shorted to the TAC module ground circuit.
- DTC U0107 sets if the TAC module ignition feed circuit is shorted to a B+ supply circuit. The TAC module stays powered-up when the ignition switch is turned OFF. When the ignition switch is turned ON, the TAC module is powered-up before the PCM. DTC U0107 sets because no communication is detected by the TAC module from the PCM. Inspect related circuits for being shorted to a B+ supply circuit.
- Inspect the TAC module power and ground circuits and the TAC module/PCM serial data circuits for intermittent connections.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.

- When the TAC module detects a problem 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 an individual condition may correct more than one DTC. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. This step determines if the ignition relay is supplying a voltage to the fuse that supplies power to the TAC module.
5. Increasing the engine speed to 3,000 RPM aids in locating a shorted throttle actuator motor control circuit. Depending on the polarity of the throttle actuator motor transistors, this DTC may not set with a fault in the control circuits. The throttle actuator motor is a bi-directional DC motor. Raising the engine speed changes the polarity of the transistors in the throttle actuator motor. This occurs because one set of the transistors is low, 0 volts, and the other set is high, B+. Therefore, if one set of transistors is at a low voltage and the corresponding circuit is shorted low, DTC P1518 will not set. When the polarity of the transistors change, this DTC sets. If this DTC does not fail this ignition, continue to monitor this DTC status while moving related harnesses and connectors.
30. Locating and repairing an individual condition may correct more than one DTC.

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Remove the cover from the underhood electrical center. 3. Test both sides of the fuse that supplies power to the throttle actuator control (TAC) module. Does the test lamp illuminate on at least one side of the fuse?	—	Go to Step 3	Go to Ignition Relay Diagnosis
3	1. Turn OFF the ignition 2. Test for voltage at the fuse that supplies power to the TAC module with a test lamp connected to ground. Does the test lamp illuminate?	—	Go to Step 23	Go to Step 4
4	Connect a scan tool. Is DTC P0604 also set?	—	Go to DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610	Go to Step 5
5	**IMPORTANT:** *If the driver information center is displaying Reduced Engine Power, go to Step 6.* 1. Start the engine. 2. Increase the engine speed to 3,000 RPM, if possible. 3. Monitor the DTC Info option using the scan tool. Does the scan tool indicate this DTC failed this ignition?	—	Go to Step 6	Go to Diagnostic Aids

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for voltage at both throttle actuator motor control circuits with a DMM. Does the DMM indicate voltage on both circuits between the specified values?	4-5V	Go to Step 12	Go to Step 7
7	Does the DMM indicate voltage above the specified value?	5V	Go to Step 12	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect TAC module connectors. 3. Test both throttle actuator motor control circuits for continuity to ground with a DMM. Does the DMM indicate continuity to ground?	—	Go to Step 11	Go to Step 9
9	1. Turn OFF the ignition. 2. Remove the that fuse supplies power to the TAC module. 3. Test the TAC side of the fuse terminal for continuity to ground with a DMM. Refer to Diagnostic Aids for terminal identification table. Does the DMM indicate continuity to ground?	—	Go to Step 10	Go to Step 12
10	1. Disconnect the TAC module 16-way harness connector. 2. Test the TAC side of the fuse terminal for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 25

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Disconnect the TAC module 16-way harness connector. 2. Test the throttle actuator motor control circuits for a short to ground at the TAC module 16-way harness connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 25
12	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way harness connector. 3. Test the TAC module ignition feed circuit for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 25
13	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for a short to voltage at both throttle actuator motor control circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 14
14	1. Turn OFF the ignition. 2. Disconnect the TAC module 10-way harness connector. 3. Test for a short between each throttle actuator motor control circuit and all other TAC module circuits with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 15
15	Test for an open or high resistance in the TAC module ground circuit with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 16

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Test for voltage on the serial data circuits at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage within the specified values for both circuits?	1-4.5V	Go to Step 17	Go to Step 19
17	1. Turn OFF the ignition. 2. Test both serial data circuits at the TAC module 16-way harness connector for continuity to ground with a DMM. Does the DMM indicate OL for both circuits?	—	Go to Step 21	Go to Step 18
18	1. Disconnect the powertrain control module (PCM) connector containing the TAC module serial data circuits. 2. Test both serial data circuits at the TAC module 16-way connector for a short to ground with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 29
19	Test for a short between both serial data circuits and all other circuits at the PCM and TAC module harness connectors with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 20
20	Test for a short to voltage on both serial data circuits at the TAC module 16-way connector with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 26

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
21	1. Disconnect the PCM connector that contains the TAC module serial data circuits. 2. Test each serial data circuit between the TAC module 16-way harness connector and the PCM harness connector for an open or high resistance with a DMM. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 22
22	1. Connect the PCM. 2. Turn ON the ignition. 3. Test for voltage on the serial data circuit at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage at the specified value?	0V	Go to Step 26	Go to Step 25
23	1.Turn OFF the ignition. 2. Disconnect the 16-way TAC module harness connector. 3. Test the TAC module ignition feed circuit for a short to battery voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 24
24	1. Turn ON the ignition. 2. Test both TAC motor circuits for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 29	Go to Step 25
25	Test for poor connections at the TAC module harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 29	Go to Step 27

DTC U0107				
Step	**Action**	**Value(s)**	**Yes**	**No**
26	Test for poor connections at the PCM harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Repairing Connector Terminals. Did you find and correct the condition?	—	Go to Step 29	Go to Step 28
27	Replace the TAC module. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 29	—
28	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 29	—
29	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 30
30	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the Diagnostic System Check - Vehicle in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes DTCs and their status.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Data Definitions

Cooling Fan Command: The percent of engine cooling fan requested from the ECM.

Desired Fan Speed: Requested fan speed from the ECM.

ECT Sensor: The scan tool displays -40°C to +151°C (-40°F to +304°F). The Engine Coolant Temperature (ECT) sensor is mounted in the coolant stream. The PCM applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold and internal resistance is high, the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms and internal resistance decreases, the voltage signal decreases and the PCM interprets the lower voltage as a warm engine.

Fan Speed: Actual fan speed.

DTC P0480 or P0481

Circuit Description

The powertrain control module (PCM) controls the low speed cooling fan operation by grounding the low speed fan relay control circuit with an internal solid state device called a driver. For high speed cooling fan operation, the PCM grounds the high speed and S/P relay control circuit at the same time the low speed control circuit is grounded. Battery positive voltage is supplied to the low speed, high speed, and S/P fan relays. When the PCM is commanding a fan relay ON, the voltage of the control circuit should be low, near 0 volts. When the PCM is commanding a fan relay OFF, the voltage potential of the control circuit should be high, near battery voltage.

The PCM monitors the relay control circuits for the following conditions:

- Short to ground
- Short to voltage
- An open circuit

If the PCM detects an improper voltage level on the low or high speed driver circuits, then code P0480 or P0481 will set and the effected driver will be disabled.

- Cooling fan relay 1 control circuit refers to the low speed cooling fan relay
- Cooling fan relay 2 control circuit refers to the high speed cooling fan relay

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0480 Cooling Fan Relay 1 Control Circuit
- DTC P0481 Cooling Fan Relay 2 Control Circuit

Conditions for Running the DTC

- The ignition voltage is between 8-18 volts.
- The engine speed is more than 40 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.

Conditions for Setting the DTC

- P0481--The PCM detects an open circuit on the high speed cooling fan relay control circuit.
- P0480--The PCM detects an open on the low speed cooling fan relay control circuit.
- The above condition is present for one second.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test has been run and failed.
- The PCM will store conditions which were present when the DTC set as Freeze Frame and Failure Records data.

Conditions for Clearing the MIL/DTC

- The PCM will turn OFF the MIL during the third consecutive trip in which the diagnostic has been run and passed.
- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

- If the condition is not present, refer to Testing for Intermittent Conditions and Poor Connections.
- Review the Freeze Frame/Failure Records vehicle mileage since the diagnostic test failed. This may help determine how often the condition that caused the DTC to be set occurs.

Test Description

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

2. Listen for an audible click when the low speed fan relay operates. Command both the ON and OFF states. Repeat the commands as necessary.
3. Listen for an audible click when the S/P and high speed fan relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

DTC P0480 or P0481				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Low Speed ON and OFF. Does the low speed fan relay turn ON and OFF with each command?	—	Go to Step 3	Go to Step 4
3	With a scan tool, command the Fans High Speed ON and OFF. Do the S/P and the high speed fan relays turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 6
4	1. Turn OFF the ignition. 2. Disconnect the low speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the low speed fan relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 16
5	1. Connect a test lamp between the control circuit of the low speed fan relay and the ignition 3 voltage circuit of the low speed fan relay. 2. With a scan tool, command the Fans Low Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 12	Go to Step 9

DTC P0480 or P0481				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	1. Turn OFF the ignition. 2. Disconnect the high speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the high speed fan relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 16
7	1. Connect a test lamp between the control circuit of the high speed fan relay and the ignition 3 voltage circuit of the high speed fan relay. 2. With a scan tool, command the Fans High Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 14	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the S/P fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the control circuit of the S/P fan relay and the ignition 3 voltage circuit of the S/P fan relay. 5. With a scan tool, command the Fans High Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 13	Go to Step 9
9	Does the test lamp remain illuminated with each command?	—	Go to Step 11	Go to Step 10
10	Test the control circuit of the appropriate relay for a short to voltage or an open. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 15

DTC P0480 or P0481				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Test the control circuit of the appropriate relay for a short to ground. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 15
12	Inspect for poor connections at the low speed fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 17
13	Inspect for poor connections at the S/P fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 18
14	Inspect for poor connections at the high speed fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 19
15	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 21	Go to Step 20
16	Repair the ignition 3 voltage circuit for an open or high resistance. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 21	—

DTC P0480 or P0481				
Step	Action	Value(s)	Yes	No
17	Replace the low speed fan relay. Did you complete the repair?	—	Go to Step 21	—
18	Replace the S/P fan relay. Did you complete the repair?	—	Go to Step 21	—
19	Replace the high speed fan relay. Did you complete the repair?	—	Go to Step 21	—
20	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 21	—
21	Use the scan tool in order to clear the DTCs. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	—	Go to Step 2	System OK

DTC P1258

Circuit Description

The powertrain control module (PCM) uses the ECT sensor to monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 132°C (270°F). When an over temperature condition is present, DTC P1258 will set. The PCM will disable two groups of four cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the PCM is able to reduce the temperature of the coolant.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P1258 Engine Coolant Overtemperature - Protection mode Active

Conditions for Running the DTC

- DTCs P0117, P0118, P1114, and P1115 are not active.
- The engine is running.

Conditions for Setting the DTC

- The engine coolant temperature is above 132°C (270°F) for 10 seconds or more.
- Action Taken When the DTC Sets
- The PCM will illuminate the malfunction indicator Lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The PCM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The PCM will alternately disable two groups of four cylinders by turning OFF the fuel injectors.
- The PCM will store conditions which were present when the DTC set as Freeze Frame and File Records data.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after 3 consecutive trips that the diagnostic has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

DTC P0526				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Check the engine cooling fans for proper operation. Are the engine cooling fans operative?	—	Go to Engine Overheating	Go to Symptoms - Engine Cooling

ENGINE COOLING

Symptoms - Engine Cooling

IMPORTANT
Review the system operation in order to familiarize yourself with the system functions. Refer to Diagnostic System Check - Vehicle.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to Checking Aftermarket Accessories.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the surge tank reservoir for the proper coolant level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Engine Overheated Indicator Always On
- Engine Coolant Temperature Indicator Always On
- Low Engine Coolant Indicator Always On
- Engine Overheating
- Loss of Coolant
- Thermostat Diagnosis
- Coolant Heater Inoperative
- Engine Fails To Reach Normal Operating Temperature
- Fan Clutch Diagnosis Engine Overheated Indicator Always On

Engine Overheated Indicator Always On

Engine Overheated Indicator Always On				
Step	**Action**	**Value(s)**	**Yes**	**No**
Connector End View Reference: Engine Cooling Schematics DEFINITION: One of the following engine coolant temperature indicators is always On: Engine Coolant, Engine Coolant Hot/Idle Engine, Engine Hot--AC Off, Engine Overheated/Stop Engine.				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Start the engine. Does the engine coolant temperature indicator illuminate?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
3	1. Install a scan tool. 2. With the scan tool, observe the engine coolant temperature parameter in the powertrain control module (PCM) data list. Does the scan tool indicate that the coolant temperature is within the temperature range shown on the temperature gage?	—	Go to Engine Overheating	Go to Step 4
4	Replace the instrument panel cluster (IPC). Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 5	—
5	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 2

Engine Coolant Temperature Indicator Always On

Engine Coolant Temperature Indicator Always On				
Step	**Action**	**Value(s)**	**Yes**	**No**
Connector End View Reference: Cooling System Connector End Views DEFINITION: One of the following engine coolant temperature indicators is always On: Engine Coolant, Engine Coolant Hot/Idle Engine, Engine Hot--AC Off, Engine Overheated/Stop Engine.				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Start the engine. Does the engine coolant temperature indicator illuminate?	—	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
3	1. Install a scan tool. 2. With the scan tool, observe the engine coolant temperature parameter in the powertrain control module (PCM) data list. Does the scan tool indicate that the coolant temperature is within the temperature range shown on the temperature gage?	—	Go to Engine Overheating	Go to Step 4
4	Replace the instrument panel cluster (IPC). Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 5	—
5	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 2

Cooling Fan Always On

Cooling Fan Always On				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Cooling Schematics Connector End View Reference: Cooling System Connector End Views DEFINITION: One or both engine cooling fan motors run continuously in high or low speed.				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Turn ON the ignition, with the engine OFF. Are both cooling fans operating at low speed?	—	Go to Step 4	Go to Step 3
3	Is the left cooling fan operating at high speed?	—	Go to Step 5	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
4	Remove the low speed fan relay. Did the fans turn OFF?	—	Go to Step 8	Go to Step 6
5	Remove the high speed fan relay. Did the left cooling fan turn OFF?	—	Go to Step 9	Go to Step 7
6	Repair the cooling fan motor supply voltage circuit of the right cooling fan for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	—	Go to Step 12	—
7	Repair the cooling fan motor supply voltage circuit of the left cooling fan for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	—	Go to Step 12	—

Cooling Fan Always On				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Inspect for poor connections at the low speed fan 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 12	Go to Step 10
9	Inspect for poor connections at the high speed fan 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 12	Go to Step 11
10	Replace the low speed fan relay. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the high speed fan relay. Did you complete the replacement?	—	Go to Step 12	—
12	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 2

Loss of Coolant

Loss of Coolant				
Step	**Action**	**Value(s)**	**Yes**	**No**
DEFINITION: The cooling system is losing coolant either internally or externally.				
1	Were you sent here from Symptoms, or another diagnostic table?	—	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle. Is the action complete?	—	Go to Step 3	—
3	Inspect the coolant level. Is the coolant at the proper level?	—	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Draining and Filling Cooling System. Is the action complete?	—	Go to Step 5	—
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	—	Go to Step 19	Go to Step 6
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	—	Go to Step 7	Go to Step 8
7	• Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. • Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	—	Go to Step 20	Go to Step 8

Loss of Coolant				
Step	**Action**	**Value(s)**	**Yes**	**No**
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	—	Go to Step 21	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Throttle body • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	—	Go to Step 21	Go to Step 10
10	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8. Are any leaks present?	—	Go to Step 21	Go to Step 11
11	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	—	Go to Step 12	Go to Step 16
12	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering near the HVAC module Is coolant present?	—	Go to Step 21	Go to Step 13

Loss of Coolant				
Step	**Action**	**Value(s)**	**Yes**	**No**
13	Inspect the underside of the engine oil fill cap for a gray/ white milky substance. Is there a milky substance under the oil fill cap?	—	Go to Step 14	Go to Step 15
14	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	—	Go to Step 17	Go to Step 15
15	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	—	Go to Step 18	Go to Step 22
16	Replace the coolant pressure cap. Is the repair complete?	—	Go to Step 22	—
17	1. Replace the radiator. 2. Service the engine oil and filter. Refer to one of the following procedures: • Engine Oil and Oil Filter Replacement for the 4.8L and 6.0L engine • Engine Oil and Oil Filter Replacement for the 8.1L engine Is the repair complete?	—	Go to Step 22	—
18	1. Replace the radiator. 2. Service the automatic transmission. Refer to one of the following procedures: • Engine Coolant/Water in Transmission for the 4L80-E/4L85-E transmission Is the repair complete?	—	Go to Step 22	—

Loss of Coolant				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Repair the engine overheating condition. Refer to Engine Overheating. Is the repair complete?	—	Go to Step 22	—
20	Repair the engine internal coolant leak. Refer to one of the following procedures: • Coolant in Combustion Chamber or Coolant in Engine Oil for the 4.3L engine • Coolant in Combustion Chamber or Coolant in Engine Oil for the 4.8L, 5.3L, and 6.0L enigne • Coolant in Combustion Chamber or Coolant in Engine Oil for the 6.6L (LLY) engine • Coolant in Combustion Chamber or Coolant in Engine Oil for the 8.1L engine Is the repair complete?	—	Go to Step 22	—
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	—	Go to Step 22	—
22	Operate the system in order to verify the repair. Did you find and correct the condition?	—	System OK	Go to Step 2

Thermostat Diagnosis

Tools Required

J 24731 Tempil Stick

Use one of the following procedures in testing for a malfunctioning thermostat.

Thermostat Test Procedure Using Tempil Sticks

The coolant thermostat can be tested using a temperature (tempil) stick. The temperature stick is a pencil like device. It has a wax material containing certain chemicals which melt at a given temperature. Temperature sticks can be used to determine a thermostat's operating range, by rubbing 87°C (188°F) and 97°C (206°F) sticks on the thermostat housing.

1.Use a tempil stick in order to find the opening and the closing temperatures of the coolant thermostat.
   -J 24731 -188 tempil stick melts at 87°C (188°F). The thermostat should begin to open.
   -J 24731 -206 tempil stick melts at 97°C (206°F). The thermostat should be fully open.
2. Replace the coolant thermostat if it does not operate properly between this temperature range.

Thermostat Test Procedure Using Glycol

Inspect the operation of the thermostat by hanging the thermostat on a hook in a 50/50 percent solution of DEX-COOL® and clean drinkable water.

In order to inspect if the thermostat valve is opening properly, perform the following test:

1. Completely submerge the thermostat in the glycol solution. The solution should be 11°C (22°F) above the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should open.

In order to inspect if the thermostat valve is closing properly, perform the following test:

1. Completely submerge the thermostat in a glycol solution. The solution should be 6°C (10°F) below the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should close completely.

Coolant Heater Inoperative (Diesel)

Circuit/System Description

The optional coolant heater operates using 110 volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather.

Reference Information

Electrical Information Reference

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

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Coolant Heater Replacement

Coolant Heater Cord Replacement

Coolant Heater Inoperative (Gasoline)

Circuit/System Description

The optional coolant heater operates using 110 volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. There is an internal thermal switch in the power cord that prevents operation above -18°C (0°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Reference Information

Electrical Information Reference

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

Circuit/System Testing

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Coolant Heater Replacement
- Coolant Heater Cord Replacement

Engine Fails To Reach Normal Operating Temperature

Engine Fails To Reach Normal Operating Temperature				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you review the Symptoms-Engine Cooling diagnostic information and perform the necessary inspections?	—	Go to Step 2	Go to Symptoms - Engine Cooling
2	Verify that the engine does not reach normal operating temperature. Does the engine reach normal operating temperature?	—	System OK	Go to Step 3
3	Inspect the coolant level. Is the coolant level below the add mark?	—	Go to Step 4	Go to Step 5
4	Add coolant as necessary. Perform a cooling system pressure test. Does the cooling system hold pressure?	—	System OK	Go to Step 5
5	Inspect for a stuck open, missing, or incorrect thermostat. Refer to Thermostat Diagnosis. Is the thermostat operating properly?	—	Go to Step 6	Go to Step 8
6	Is the vehicle equipped with a 6.6 L diesel engine?	—	Go to Step 7	Go to Step 8
7	Inspect for a faulty turbocharger coolant bypass valve. Is the turbocharger coolant bypass valve functioning properly?	—	—	Go to Step 9
8	Install the correct replacement thermostat. Is the repair complete?	—	Go to Step 10	—

Engine Fails To Reach Normal Operating Temperature				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Install a new turbocharger coolant bypass valve. Is the repair complete?	—	Go to Step 10	—
10	Run the engine in order to verify the repair. Does the engine fail to reach normal operating temperature?	—	—	System OK

Pressure Cap Testing

Tools required

- J 24460-01 Cooling System Pressure Tester
- J 42401 Radiator Cap / Surge Tank Test Adapter

Pressure Cap Testing

CAUTION

To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.
3. Use the J 24460-01 (1) with J 42401 (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
   -Pressure release when the J 24460-01 exceeds the pressure rating of the pressure cap.
   -Maintain the rated pressure for at least 10 seconds. Note the rate of pressure loss.
5. Replace the pressure cap under the following conditions:
   -The pressure cap does not release pressure which exceeds the rated pressure of the cap.
   -The pressure cap does not hold the rated pressure.

Cooling System Leak Testing

Tools Required

- J 24460-01 Cooling System Pressure Tester
- J 42401 Radiator Cap/ Surge Tank Test Adapter

CAUTION

Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

CAUTION

In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to Pressure Cap Testing.
3. Wash the pressure cap mating surface with water.
4. Use the J 24460-01 with the J 42401 in order to apply pressure to the cooling system. Do not exceed the pressure cap rating.
5. The cooling system should hold the rated pressure for at least 2 minutes. Observe the gage for any pressure loss.
6. Repair any leaks as required.

Fan Clutch Diagnosis

Fan Clutch Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Were you sent here from Symptoms or another diagnostic table?	—	Go to Step 2	Go to Symptoms - Engine Cooling
2	Is there excessive fan air noise?	—	Go to Step 3	Go to Step 4
3	Fan air noise is normal during cold engine start up. Does the fan noise go away at normal engine operating temperature?	—	Go to Step 13	Go to Step 4
4	**IMPORTANT** *The engine must be turned OFF and the engine temperature should be cold.* Rotate the fan clutch. Does the fan clutch rotate?	—	Go to Step 5	Go to Step 14
5	Visually inspect the fan blades for cracks, looseness or damage. Are the fan blades in good condition?	—	Go to Step 6	Go to Step 15
6	Visually inspect the fan clutch for signs of silicone leakage. • Slight silicone leakage may not effect the fan clutch engagement. • Excess leakage will prevent the fan clutch from engaging. Is the silicone fluid leakage excessive?	—	Go to Step 14	Go to Step 7

Fan Clutch Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Inspect the fan clutch for proper installation. 1. Move the fan blade back and forth in a lateral motion. 2. Inspect for fan blade to fan clutch movement. Is the fan blade loose at the fan clutch?	—	Go to Step 10	Go to Step 8
8	Inspect the fan clutch for wear. 1. Move the fan blade back and forth in a lateral motion. **IMPORTANT** *Approximately 6.5 mm (¼ in) movement at the tip of the fan blade is normal.* 2. Inspect for fan clutch lateral movement. Is the fan clutch lateral movement excessive?	—	Go to Step 14	Go to Step 9
9	The fan clutch should have more turning resistance when the engine is at or above normal operating temperature. Does the fan clutch have more resistance when the engine temperature is raised?	—	Go to Step 11	Go to Step 14
10	Tighten the fan. Refer to Fastener Tightening Specifications. Is the repair complete?	—	Go to Step 16	—

Fan Clutch Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	Perform a fan clutch engagement test. 1. Ensure the engine coolant level is full. 2. Ensure the cooling fan drive belt tension is correct and not slipping. 3. Position and secure a thermometer between the fan clutch and the radiator. 4. Ensure the cooling fan is disengaged before starting this test. 5. Sufficiently cover the radiator grille to restrict the air flow. **IMPORTANT** *Do not allow engine temperature to exceed 121°C (250°F).* 6. Start the engine. 7. Turn the A/C ON, if equipped. 8. Operate the engine at approximately 2,000 RPM. 9. Inspect the thermometer reading when the fan clutch engages. 10. Do not continue this test if the fan clutch does not engage between 85-96°C (185-205°F). Fan clutch engagement will be indicated by an increase in fan air noise, fan speed, and a drop of about 3-10°C (5-15°F) on the thermometer reading. Did the fan clutch engage between 85-96°C (185-205°F)?	—	Go to Step 12	Go to Step 14

Fan Clutch Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Once the fan clutch engages, perform the following steps: 1. Uncover the radiator grille. 2. Turn the A/C OFF, if equipped. 3. Operate the engine at approximately 2,500 RPM to reduce the engine operating temperature. 4. Remove the thermometer. Did the engine return to normal operating temperature?	—	Go to Step 13	—
13	As the engine temperature returns to normal, the fan clutch will disengage, indicated by a reduction in fan air noise and fan speed. Did the fan clutch disengage?	—	Go to Step 16	Go to Step 14
14	Replace the fan clutch. Is the repair complete?	—	Go to Step 16	—
15	Replace the fan blades. Is the repair complete?	—	Go to Step 16	—
16	Operate the fan clutch to verify proper operation. Did you find and correct the condition?	—	System OK	Go to Step 2

ENGINE ELECTRICAL

Diagnostic Starting Point - Engine Electrical

Begin the system diagnosis with the Diagnostic System Check - Vehicle. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Data Definitions

Ignition 1 Signal

The scan tool displays the current voltage at the battery.

GEN L--Terminal Signal Command

The scan tool displays OK/No Output. The scan tool displays OK until malfunction is detected on the generator L terminal circuit, then it reads No Output.

GEN F--Terminal Signal

The scan tool displays 0%-100%. The scan tool displays 0%-5% until the engine is running, then the percentage value varies depending on electrical loads

Diagnostic Aids

IMPORTANT

You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

DTC P0562

Circuit Description

The powertrain control module (PCM) monitors the system voltage to make sure that the voltage stays within the proper range. If the PCM detects an excessively low system voltage, DTC P0562 will set.

When the charging system detects a fault, the instrument panel cluster (IPC) displays a message or the charge indicator will light.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0562 System Voltage Low

Conditions for Running the DTC

- Engine run time more than 20 seconds and above 1, 200 RPM
- Vehicle speed above 8 km/h (5 mph)

Conditions for Setting the DTC

The PCM detects an improper voltage below 11 volts for 5 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The PCM will store conditions which were present when the DTC set as Failure Records data only.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The IPC displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.
- The PCM receives the clear code command from the scan tool.

DTC P0562				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	With the scan tool monitor the Ignition 1 signal voltage in the powertrain control module (PCM) data list. Does the scan tool display Ignition 1 voltage greater than the specified value?	10.5 V	Go to Step 4	Go to Step 3
3	Test the ignition feed circuit to the PCM for high resistance or open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
4	1. Inspect for poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections. 2. If you find a poor connection, repair the condition as necessary. Refer to Wiring Repairs. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair the ignition feed circuit to the PCM for an open or a short to ground. Refer to Wiring Repairs. Is the action complete?	—	Go to Step 7	—
6	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Is the action complete?	—	Go to Step 7	—

DTC P0562				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text, if applicable. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0563

Circuit Description

The powertrain control module (PCM) continuously monitors that the system voltage stays within the proper range. If the PCM detects an excessively high system voltage, DTC P0563 will set. A high voltage condition may cause a stalling condition or other driveability concerns.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0563 System Voltage High

Conditions for Running the DTC

- The engine run time is more than 20 seconds.
- Engine running above 1, 200 RPM
- Vehicle speed above 8 km/h (5 mph)

Conditions for Setting the DTC

- The PCM senses the system voltage is above 19 volts.
- All of the conditions are present for 5 seconds.

Action Taken When the DTC Sets

- The PCM stores DTC P0563 in the PCM memory when the diagnostic runs and fails.
- The PCM will record the operating conditions at the time the diagnostic fails. The PCM stores this information in Failure Records.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The instrument panel cluster (IPC) displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.
- The PCM receives the clear code command from the scan tool.

DTC P0563				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn OFF all the accessories. 2. Measure the battery voltage at the battery using the DMM. 3. Operate the engine speed above 2, 000 RPM. Is the battery voltage less than the specified value?	19 V	Go to Step 4	Go to Step 3
3	Replace the generator. Is the action complete?	—	Go to Step 5	—
4	Replace the powertrain control module (PCM). Refer to Control Module References for replacement, setup, and programming. Is the action complete?	—	Go to Step 5	—
5	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text, if applicable. Does the DTC reset?	—	Go to Step 2	System OK

DTC P0615

Circuit Description

The powertrain control module (PCM) uses output driver modules (ODMs) to control many functions of the engine. The ODMs supply the ground path for the PCM controlled device when the PCM commands the device ON. Each ODM is able to control several outputs. The PCM monitors the ODMs for circuit conditions that are incorrect for the commanded state of the ODM. If the PCM detects an improper circuit condition in the ODM that controls the starter relay, DTC P0615 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

- DTC P0615 Starter Relay Circuit

Conditions for Running the DTC

System voltage is between 8-16 volts.

Conditions for Setting the DTC

- The PCM detects an improper voltage level on the output circuit that controls the starter relay.
- The condition exists for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store the conditions present when the DTC set as Fail Records data only.

Conditions for Clearing the MIL/DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

Ignition system DTCs set with the ignition switch in the START position if the starter relay or the starter is inoperative. When the PCM enables starter operation, the PCM also initiates the diagnostic test routines for DTCs P0335, P0340, and P0385. If a condition exists which prevents the engine from cranking, the PCM will not receive signal input from the crankshaft position (CKP) and camshaft position (CMP) sensors, and the DTCs will set.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may assist in diagnosing the condition. The information may help determine how often the condition that set the DTC occurs.

Test Description

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

2. Listen for an audible click when the start 1 relay operates. Turn the ignition switch back and forth from the ON to START positions. Repeat this as necessary.
3. This step tests for voltage at the coil side of the start 1 relay. The PCM IGN fuse supplies power to the coil side of the start 1 relay.
4. This step verifies that the PCM is providing ground to the start 1 relay.
5. This step tests if ground is constantly being applied to the start 1 relay.

DTC P0615				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Turn the ignition back and forth from the ON to START positions. Does the start 1 relay turn ON and OFF with each command?	—	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the start 1 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage of the start 1 relay coil circuit with a test lamp that is connected to a good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 8
4	1. Connect a test lamp between the control circuit of the start 1 relay and the battery positive voltage of the start 1 relay coil circuit. 2. Turn the ignition back and forth from the ON to START positions. Does the test lamp turn ON and OFF with each command?	—	Go to Step 6	Go to Step 5
5	Test the control circuit of the start 1 relay for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 7

DTC P0615				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Inspect for poor connections at the start 1 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
7	Inspect for poor connections at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
8	Repair the battery positive voltage circuit of the start 1 relay. Refer to Connector Repairs. Did you complete the repair?	—	Go to Step 11	—
9	Replace the start 1 relay. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 11	—
11	1. Review and record the scan tool Fail Records data. 2. Use the scan tool in order to clear the DTC. 3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. 4. Using the scan tool, observe the Specific DTC Information for DTC P0615 until the test runs. Does the scan tool indicate that DTC P0615 failed this ignition?	—	Go to Step 2	System OK

Symptoms - Engine Controls

Important Preliminary Inspections Before Starting

Perform Diagnostic System Check - Vehicle before using the symptom tables, and verify that all of the following are true:

- The powertrain control module (PCM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Verify that the engine is not in a torque reduction mode. The PCM turns certain injectors OFF or reduces the engine timing when the PCM detects an over torque condition or an abusive maneuver.
- Verify that the engine coolant temperature (ECT) is not above 130°C (266°F). This condition causes the PCM to operate in Engine Coolant Over Temperature-Fuel Disabled Mode. While in Engine Coolant Over Temperature-Fuel Disabled Mode, the PCM turns the fuel OFF to four cylinders at a time in order to keep engine temperatures from reaching damaging levels. The system perceives Engine Coolant Over Temperature as a lack of power, miss, or rough idle. If the vehicle is operating in Engine Coolant Over Temperature-Fuel Disabled Mode, refer to Engine Overheating for diagnosis.
- The scan tool data is within the normal operating range, refer to Scan Tool Data List.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual/Physical Inspection

Several of the symptom procedures ask for a careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a condition without further inspections, and can save valuable time. Ensure that:

- The PCM grounds are clean, tight, and in the proper location.
- The vacuum hoses are not split or kinked, and properly connected, as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- The mass air flow (MAF) sensor is properly installed. The arrows on the plastic portion of the sensor must point toward the engine.
- The air intake ducts are not collapsed or damaged.
- There are no leaks at the throttle body mounting area, the MAF sensor, or the intake manifold sealing surfaces.
- The ignition wires are not cracked, brittle, or carbon tracked.
- The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

IMPORTANT

Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone communication signal may cause the condition.

IMPORTANT

The condition may or may not turn ON the MIL or store a DTC.

Faulty electrical connections or wiring cause most intermittent conditions. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
- Terminals that are not seated
- Terminals that are damaged or improperly formed

Reform or replace connector terminals in the affected circuit to ensure proper contact tension. Refer to Connector Repairs. Remove the terminal from the connector body in order to inspect for poor terminal wire connection. Refer to Testing for Intermittent Conditions and Poor Connections.

Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that is observed when the symptom occurs is a good indication that there is a malfunction in the circuit being monitored.

Use a scan tool to help detect intermittent conditions. Useful features of the Tech 2scan tool include the following:

- Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
- Freeze Frame/Failure Records can also aid in locating an intermittent condition. Review and capture the information in the Freeze Frame/Failure Record associated with the intermittent DTC being diagnosed. Drive the vehicle within the conditions that were present when the DTC originally set.
- Use the Plot Function on the scan tool to plot selected data parameters. Review this stored information to aid in locating an intermittent condition. Refer to the scan tool Users Guide for more information.

IMPORTANT

If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent MIL with no stored DTC:

- The ignition coils are shorted to a ground or arcing at the ignition wires or the spark plugs.
- The PCM grounds are loose or dirty. Refer to Engine Controls Schematics.
- The ignition control (IC) wires are routed too close to the secondary ignition wires, coils, or the generator. Ensure that all of the circuits from the PCM to the ignition coils have good connections.
- There is an open diode across the A/C compressor clutch or any other open diodes.

Use the following tables when diagnosing a symptom complaint:

- Testing for Intermittent Conditions and Poor Connections
- Hard Start
- Surges/Chuggles
- Lack of Power, Sluggishness, or Sponginess
- Detonation/Spark Knock
- Hesitation, Sag, Stumble
- Cuts Out, Misses
- Poor Fuel Economy
- Poor Fuel Fill Quality
- Rough, Unstable, or Incorrect Idle and Stalling
- Dieseling, Run-On
- Backfire

Hard Start

<table>
<tr><th colspan="2">Hard Start</th></tr>
<tr><th>Inspection/Test</th><th>Action</th></tr>
<tr><td colspan="2">DEFINITION: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.</td></tr>
<tr><td>Preliminary</td><td>• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls.
• Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Power and Grounding Component Views and Engine Controls Schematics.
• Search for bulletins.</td></tr>
<tr><td>Sensor/System</td><td>• Verify that the engine coolant temperature (ECT) sensor is not shifted in value. Connect a scan tool. Compare the engine coolant temperature to the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C (5°F) of each other. If the ECT sensor is out of range with the IAT sensor, measure the resistance of the ECT sensor. Refer to Temperature Versus Resistance for resistance specifications.
• Inspect the mass air flow (MAF) sensor installation. A MAF sensor that is incorrectly installed may cause a hard start.
IMPORTANT:
The embossed arrows on the MAF sensor indicate the direction of the intake air flow. The arrows must point toward the engine. Install the MAF in the proper direction. Refer to Mass Airflow Sensor/Intake Air Temperature Sensor Replacement.
• Inspect the camshaft position (CMP) sensor for proper mounting and/or a bad connection. An extended crank occurs if the PCM does not receive a CMP signal.</td></tr>
<tr><td>Fuel System</td><td>• Verify that the engine coolant temperature (ECT) sensor is not shifted in value. Connect a scan tool. Compare the engine coolant temperature to the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C (5°F) of each other. If the ECT sensor is out of range with the IAT sensor, measure the resistance of the ECT sensor. Refer to Temperature Versus Resistance for resistance specifications.
• Inspect the mass air flow (MAF) sensor installation. A MAF sensor that is incorrectly installed may cause a hard start.
IMPORTANT:
The embossed arrows on the MAF sensor indicate the direction of the intake air flow. The arrows must point toward the engine. Install the MAF in the proper direction. Refer to Mass Airflow Sensor/Intake Air Temperature Sensor Replacement.
• Inspect the camshaft position (CMP) sensor for proper mounting and/or a bad connection. An extended crank occurs if the PCM does not receive a CMP signal.</td></tr>
</table>

Hard Start	
Inspection/Test	**Action**
Ignition System	Verify that both fuel injector fuses are not open. An open fuel injector fuse causes four ignition coils and four fuel injectors not to operate. Inspect the ignition coil circuits and the fuel injector circuits for an intermittent short to ground. Refer to Circuit Testing. Replace the fuse. • Inspect for proper ignition voltage output with the J 26792 Spark Tester. Refer to Electronic Ignition (EI) System Diagnosis. • Remove the spark plugs and inspect for the following conditions: – Correct heat range – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • Determine the cause of the conditions before replacing the spark plugs. • Inspect for bare or shorted ignition wires. Refer to Spark Plug Wire Inspection.
Engine Mechanical	Inspect for the following conditions: • Excessive oil in combustion chamber or leaking valve seals. • Low cylinder compression. • Combustion chambers for excessive carbon buildup--Clean the chambers using top engine cleaner. Follow the instructions on the can. • Incorrect basic or worn engine parts--Inspect the following: – Cylinder heads – Camshaft – Pistons, etc.

Surges/Chuggles

Surges/Chuggles	
Inspection/Test	**Action**
DEFINITION: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Inspect the powertrain control module (PCM) grounds for being clean, tight, and in the proper locations. Refer to Power and Grounding Component Views in Wiring Systems and Engine Controls Schematics. • Verify the driver understands the operation of the transmission torque converter clutch (TCC) and A/C compressor operation as explained in the owners manual. Inform the customer how the TCC and the A/C clutch operates.
Sensor/System	**NOTICE:** *Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.* • Inspect the heated oxygen sensors (HO2S). The HO2S should respond quickly to different throttle positions. If they do not, inspect the HO2S for silicon or other contaminates from fuel or the use of improper RTV sealant. The sensors may have a white, powdery coating and result in a high but false signal voltage rich exhaust indication. The PCM will then reduce the amount of fuel delivered to the engine causing a severe driveability problem. • Inspect the mass air flow (MAF) sensor connections. Repair or replace damaged terminals. Refer to Connector Repairs.

Surges/Chuggles	
Inspection/Test	**Action**
Fuel System	• Test for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Verify that each injector harness is connected to the correct injector or cylinder. Relocate injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – Engine oil contaminated by fuel – An EVAP canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor – Blockage on the inlet screen of the MAF sensor--Refer to Manifold Absolute Pressure Sensor Replac – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted. – An air filter that is dirty or restricted. • Inspect for the following conditions that may cause the engine to run lean: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – An exhaust leak between the HO2S and the engine. – Vacuum leaks – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Restricted fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate MAF sensor – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Vacuum hoses that are split, kinked, or improperly connected

Surges/Chuggles	
Inspection/Test	**Action**
Ignition System	• Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water. • Test for proper ignition voltage output with the J 26792 Spark Tester. Refer to Electronic Ignition (EI) System Diagnosis. • Remove the spark plugs and inspect for the following conditions: – Correct heat range – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection • An improper spark plug gap will cause a driveability problem. Gap the spark plugs using a wire gauge gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. • Monitor the Misfire Current Counters while driving the vehicle within the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.
Engine Mechanical	Verify that the engine coolant temperature (ECT) is not above 130°C (266°F). This condition causes the PCM to operate in Engine Coolant Over Temperature - Fuel Disabled Mode. While in Engine Coolant Over Temperature - Fuel Disabled Mode, the PCM turns fuel OFF to four cylinders at a time to keep engine temperatures from reaching damaging levels. The system perceives Engine Coolant Over Temperature - Fuel Disabled Mode as a lack of power, miss, or rough idle. If the vehicle operates in Engine Coolant Over Temperature - Fuel Disabled Mode, refer to Engine Overheating for diagnosis.
Additional Inspections	• Visually and physically inspect vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label. • Inspect the transmission torque converter clutch (TCC) operation. A TCC applying too soon can cause the engine to spark knock. Refer to Diagnostic Starting Point - Automatic Transmission.

Lack of Power, Sluggishness, or Sponginess

Lack of Power, Sluggishness, or Sponginess	
Inspection/Test	**Action**
DEFINITION: Engine delivers less than expected power. Little or no increase in speed when the accelerator pedal is pushed down part way.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Power and Grounding Component Views and Engine Controls Schematics. • Remove the air filter element and inspect for dirt or for restrictions.
Sensor/System	Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to Knock Sensor (KS) System Description.

Lack of Power, Sluggishness, or Sponginess	
Inspection/Test	**Action**
Fuel System	• Inspect both injector fuses for being open. An open injector fuse causes four ignition coils and four injectors not to operate. Replace the fuse. Inspect the ignition coil circuits and the injector circuits for an intermittent short to ground. • Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Inspect the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – Engine oil contaminated by fuel – An EVAP canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor – Blockage on the inlet screen of the MAF sensor--Refer to Manifold Absolute Pressure Sensor Replacement. – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted. – An air filter that is dirty or restricted. • Inspect for the following conditions that may cause the engine to run lean: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – An exhaust leak between the HO2S and the engine. – Vacuum leaks – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Restricted fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate MAF sensor – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Vacuum hoses that are split, kinked, or improperly connected

Lack of Power, Sluggishness, or Sponginess	
Inspection/Test	**Action**
Ignition System	• Verify that both fuel injector fuses are not open. An open fuel injector fuse causes four ignition coils and four fuel injectors not to operate. Inspect the ignition coil circuit and the injector circuits for an intermittent short to ground. Refer to Circuit Testing. Replace the fuse. • Inspect the secondary ignition components for signs of damage to to excessive heat in the engine compartment. • Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as water is applied. • Inspect for proper ignition voltage output with the J 26792 Spark Tester. • Remove the spark plugs and inspect for the following conditions: – Correct heat range – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection • An improper spark plug gap will cause a driveability problem. Gap the spark plugs using a wire gauge gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. • Monitor the Misfire Current Counters while driving the vehicle within the conditions that the misfire occurred. If a misfiring cylinder can be located with a misfire, use the DTC P0300 table for diagnosis. Refer to DTC P0300. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.

Lack of Power, Sluggishness, or Sponginess	
Inspection/Test	**Action**
Engine Mechanical	•Verify that the engine coolant temperature (ECT) is not above 130°C (266°F). This condition causes the PCM to operate in Engine Coolant Over Temperature - Fuel Disabled Mode. While in Engine Coolant Over Temperature - Fuel Disabled Mode, the PCM will disable the fuel injectors to four cylinders at a time to keep engine temperatures from reaching damaging levels. The system perceives the Engine Coolant Over Temperature - Fuel Disabled Mode as a lack of power, miss, or rough idle. If the vehicle operates in Engine Coolant Over Temperature - Fuel Disabled Mode, refer to Engine Overheating for diagnosis. • Inspect for excessive oil in the combustion chambers and leaking valve seals. • Test for low cylinder compression. • Inspect for incorrect basic engine parts, including the following: – The camshaft – The cylinder heads – The pistons, etc.
Additional Inspections	• Inspect the exhaust system for possible restrictions. Perform the following: – Inspect the exhaust system for damaged or collapsed pipes. – Inspect the mufflers for heat distress or internal failure. – Inspect for plugged three-way catalytic converters by comparing the exhaust system back pressure on each side of the engine. Test back pressure by removing the secondary air injection (AIR) check valves near the exhaust manifolds. Refer to Restricted Exhaust.

Detonation/Spark Knock

<table>
<tr><th colspan="2">Detonation/Spark Knock</th></tr>
<tr><th>Inspection/Test</th><th>Action</th></tr>
<tr><td colspan="2">DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.</td></tr>
<tr><td>Preliminary Inspections</td><td>• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls.
• Search for bulletins.
• Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Power and Grounding Component Views and Engine Controls Schematics.
• If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicles minimum octane requirements. Road test the vehicle and re-evaluate the vehicles performance.</td></tr>
<tr><td>Fuel System</td><td>• Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis.
• Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis.
• Inspect for the following conditions that may cause the engine to run lean:
NOTICE:
Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.
– Water intrusion in the heated oxygen sensor (HO2S) connector
– An exhaust leak between the HO2S and the engine.
– Vacuum leaks
– Incorrect fuel pressure--Refer to Fuel System Diagnosis.
– Restricted fuel injectors--Refer to Fuel System Diagnosis.
– An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List.
– Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis.
– Vacuum hoses that are split, kinked, or improperly connected</td></tr>
<tr><td>Ignition System</td><td>Verify that the spark plugs are of the proper heat range. Refer to Spark Plug Inspection.</td></tr>
<tr><td>Engine Cooling System</td><td>Inspect for obvious overheating conditions:
• Low engine coolant--Refer to Loss of Coolant for the type and amount of engine coolant to be used.
• Restricted air flow to the radiator or restricted coolant flow through the radiator
• Inoperative cooling fan.</td></tr>
</table>

Detonation/Spark Knock	
Inspection/Test	**Action**
Engine Mechanical	Inspect for the following engine mechanical conditions: • Excessive oil in combustion chamber--Leaking valve seals. • Low cylinder compression. • Combustion chambers for excessive carbon buildup--Clean the combustion chamber by using top engine cleaner. Follow the instructions on the can. • Inspect for incorrect basic engine parts. Inspect the following: – The camshaft. – The cylinder heads – The pistons, etc.
Additional Inspections	• Inspect the park/neutral position (PNP) switch operation. • Inspect the transmission torque converter clutch (TCC) operation. The TCC applying too soon can cause the engine to spark knock.

Hesitation, Sag, Stumble

Hesitation, Sag, Stumble	
Inspection/Test	**Action**
DEFINITION: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually more pronounced when first trying to make the vehicle move, as from a stop. May cause the engine to stall if severe enough.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Ground Distribution Schematics.
Sensor/System	Inspect the manifold absolute pressure (MAP) sensor operation.

Hesitation, Sag, Stumble	
Inspection/Test	**Action**
Fuel System	• Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Verify that both fuel injector fuses are not open. An open fuel injector fuse causes 4 ignition coils and 4 fuel injectors not to operate. Inspect the ignition coil circuits and the fuel injector circuits for an intermittent short to ground. Refer to Circuit Testing and Wiring Repairs. Replace the fuse. • Inspect the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the heated oxygen sensor (HO2S) connector – Engine oil contaminated by fuel – An evaporative emission (EVAP) canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – Blockage on the inlet screen of the MAF sensor--Refer to Manifold Absolute Pressure Sensor Replacement. – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted. – An air filter that is dirty or restricted. • Inspect for the following conditions that may cause the engine to run lean: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – An exhaust leak between the HO2S and the engine. – Vacuum leaks – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Restricted fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate MAF sensor--Refer to Scan Tool Data List. – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Vacuum hoses that are split, kinked, or improperly connected

Hesitation, Sag, Stumble	
Inspection/Test	**Action**
Ignition System	• Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water. • Test for proper ignition voltage output with the J 26792 Spark Tester. Refer to Electronic Ignition (EI) System Diagnosis for the procedure. • Remove the spark plugs and inspect for the following conditions: – Correct heat range – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • An improper spark plug gap will cause a driveability condition. Gap the spark plugs using a wire gage gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.
Engine Cooling System	Inspect the engine thermostat for proper operation and for proper heat range. Refer to Thermostat Diagnosis.
Additional Inspections	Inspect the generator output voltage. Repair the charging system if the generator output voltage is less than 9 volts or more than 16 volts.

Cuts Out, Misses

Cuts Out, Misses	
Inspection/Test	**Action**
DEFINITION: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or low speed.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Power and Grounding Component Views and Engine Controls Schematics. • Remove the air filter element and inspect for dirt and for restrictions.
Sensor/System	Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity.

Cuts Out, Misses	
Inspection/Test	**Action**
Fuel System	• Test the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the heated oxygen sensor (HO2S) connector – Engine oil contaminated by fuel – An evaporative emission (EVAP) canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – Blockage on the inlet screen of the MAF sensor – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted. – An air filter that is dirty or restricted. • Inspect for the following conditions that may cause the engine to run lean: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – An exhaust leak between the HO2S and the engine. – Vacuum leaks – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Restricted fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate MAF sensor--Refer to Scan Tool Data List. – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Vacuum hoses that are split, kinked, or improperly connected

Cuts Out, Misses	
Inspection/Test	**Action**
Ignition System	• Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water. • Test for proper ignition voltage output with the J 26792 Spark Tester. • Remove the spark plugs and inspect for the following conditions: – Correct heat range – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • An improper spark plug gap may cause a driveability problem. Refer to Spark Plug Inspection. Gap the spark plugs using a wire gauge gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. • Visually and physically inspect the secondary ignition for the following conditions: – The ignition wires arcing to ground – The ignition wires for proper engagement to spark plug – The ignition coils for cracks or carbon tracking • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300.

Cuts Out, Misses	
Inspection/Test	**Action**
Engine Mechanical	• Inspect engine mechanical for the following conditions: – Inspect compression. – Sticking or leaking valves – Worn camshaft lobes – Valve timing – Bent push rods – Worn rocker arms – Broken valve springs – Excessive oil in combustion chamber. • For incorrect basic engine parts inspect the following: – The camshaft – The cylinder heads – The pistons, etc.
Additional Inspections	• Inspect the exhaust system for possible restrictions. Inspect for the following: – Inspect the exhaust system for damaged or collapsed pipes. – Inspect the mufflers for heat distress or possible internal failure. – Inspect for possible plugged catalytic converters by comparing the exhaust system back pressure on each side of engine. Refer to Restricted Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine misfire condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present. Inspect for high voltage components near ignition control circuits if a condition exists. • Inspect the intake manifold and the exhaust manifold passages for casting flash.

Poor Fuel Economy

Poor Fuel Economy	
Inspection/Test	**Action**
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, fuel economy is noticeably lower than the economy was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to Power and Grounding Component Views and Engine Controls Schematics. • Inspect the owners driving habits for the following conditions: – The A/C ON or the Defroster mode ON full time – The tires at the correct pressure – Excessively heavy loads being carried – The acceleration rate is too much, too often • Remove the air filter element and inspect for dirt or for restrictions. Replace as necessary.
Sensor/System	• Inspect the air intake system and crankcase for air leaks. • Inspect the crankcase ventilation system. Refer to Crankcase Ventilation System Inspection/Diagnosis. • Inspect for an inaccurate speedometer. Refer to Instrument Cluster Gages Inoperative. • Monitor the knock sensor (KS) system for excessive spark retard activity with a scan tool. Refer to Knock Sensor (KS) System Description.

Poor Fuel Economy	
Inspection/Test	**Action**
Fuel System	• Inspect the type, quality, and alcohol content of the fuel. Oxygenated fuels have lower energy and may deliver reduced fuel economy. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Test the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Inspect that each fuel injector harness is connected to the correct injector and cylinder. Relocate the injector harnesses as necessary. • Inspect for foreign material accumulation in the throttle bore, coking on the throttle valve, or on the throttle shaft. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the heated oxygen sensor (HO2S) connector – Engine oil contaminated by fuel – An evaporative emission (EVAP) canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor--Refer to Scan Tool Data List. – Blockage on the inlet screen of the MAF sensor--Refer to Manifold Absolute Pressure Sensor Replacement. – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted. – An air filter that is dirty or restricted.

Poor Fuel Economy	
Inspection/Test	**Action**
Ignition System	• Inspect for proper ignition voltage output with the J 26792 Spark Tester. • Remove the spark plugs and inspect for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • An improper spark plug gap will cause a driveability condition. Refer to Spark Plug Inspection. Gap the spark plugs using a wire gage gap tool Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. Refer to Spark Plug Inspection. • Visually and physically inspect the secondary ignition for the following conditions: – Ignition wires arcing to ground – Ignition wires for proper routing • Soaking the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.
Engine Cooling System	• Inspect the engine coolant level for being low. Refer to Loss of Coolant. • Inspect the engine thermostat for proper operation and for the correct heat range. Refer to Thermostat Diagnosis.

Poor Fuel Economy	
Inspection/Test	**Action**
Engine Mechanical	• Inspect engine mechanical for the following conditions: – Compression – Sticking or leaking valves – Worn camshaft lobes – Valve timing – Bent push rods – Worn rocker arms – Broken valve springs – Excessive oil in combustion chamber--Leaking valve seals. • For incorrect basic engine parts inspect for the following: – The camshaft – The cylinder heads – The pistons, etc.
Additional Inspections	• Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections and routing as shown on Vehicle Emission Control Information label. • Inspect the transmission torque converter clutch (TCC) operation. The scan tool should indicate a RPM drop, when the system commands the TCC ON. Refer to Torque Converter Diagnosis. • Inspect the exhaust system for a possible restriction. Inspect for the following: – The exhaust system for damaged or collapsed pipes – The mufflers for heat distress or possible internal failure – For possible plugged three-way catalytic converters by comparing the exhaust system back pressure on each side of the engine--Inspect the back pressure by removing the secondary air injection (AIR) check valves near the exhaust manifolds. Refer to Restricted Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change indicates EMI is present. Inspect for high voltage components, near ignition control circuits, if a condition exists. • Inspect the park neutral position (PNP) switch circuit. Refer to Range Selector Displays Incorrect Range for the 4L60-E/4L65-E transmission or Range Selector Displays Incorrect Range for the 4L80-E/4L85-E transmission. • Inspect the brake system for dragging or improper operation. Verify that the vehicle operator does not drive with a foot on the brake pedal.

Poor Fuel Fill Quality

Poor Fuel Fill Quality	
Inspection/Test	**Action**
DEFINITION: Difficulty when refueling the vehicle.	
Difficult to fill	• If the vehicle is equipped with dual fuel tanks and a single filler neck the flow of the fuel into the tanks may exceed the ability of the system to compensate, the fill nozzle will automatically shut off. The system will require 10-20 seconds to equalize pressure before filling can resume. **NOTICE:** *Workhorse does not install dual fuel tanks. ANY issue arising from the installation of an auxiliary fuel tank should be directed to the body builder.* • The check valve is stuck closed. • The fill limiter vent valve is stuck closed. • The evaporative emission (EVAP) canister is restricted. Refer to Evaporative Emission (EVAP) Canister Replacement. • The EVAP canister vent solenoid is stuck closed. • Restricted EVAP pipes • High Reid Vapor Pressure • High fuel temperature • The fuel filler hose/pipe is pinched, kinked or blocked. • The fuel feed hose, or crossover hose, is pinched, kinked or blocked. Refer to Fuel Rail Assembly Replacement. • The ignition switch is ON.
Over fill	• The pressure relief valve in the fill limiter vent valve, if equipped, is stuck open. • The pressure relief valve in the fill limiter vent is valve, if equipped, leaking. • The fill limiter vent valve, if equipped, is stuck open. • The fill limiter vent valve, if equipped, is leaking.

Poor Fuel Fill Quality	
Inspection/Test	**Action**
Premature shut-off of the fuel dispensing nozzle	• The fill limiter vent valve, if equipped, is stuck closed. • The EVAP canister is restricted. Refer to Evaporative Emission (EVAP) Canister Replacement. • The EVAP canister vent solenoid is stuck closed. • Restricted EVAP pipes--Refer to Evaporative Emission (EVAP) Hoses/Pipes Replacement - Canister/Fuel Tank. • High Reid vapor pressure • High fuel temperature • The fuel filler hose/pipe is pinched, kinked or blocked. • The fuel feed hose, or crossover hose, if equipped, is pinched, kinked or blocked. • The ignition switch is ON.
Fuel spit back	• The check valve is stuck open. • The check valve is stuck closed. • The check valve is leaking. • High Reid vapor pressure • High fuel temperature
Liquid fuel in the EVAP canister	• The fill limiter vent valve is stuck open. • The fill limiter vent valve is leaking.
Liquid fuel leak	• The pressure relief valve in the fill limiter vent valve is stuck open. • The pressure relief valve in the fill limiter vent valve is leaking. • The fuel filler hose is loose or torn. Refer to Filler Tube Replacement. • The fuel feed hose, or crossover hose, is loose or torn. Refer to Fuel Rail Assembly Replacement. • The fill limiter vent valve is stuck open.
Fuel odor	• The pressure relief valve in the fill limiter vent valve, if equipped, is stuck open. • The pressure relief valve in the fill limiter vent valve, if equipped, is leaking. • The EVAP canister is saturated. Refer to Evaporative Emission (EVAP) Canister Replacement.

Rough, Unstable, or Incorrect Idle and Stalling

Rough, Unstable, or Incorrect Idle and Stalling	
Inspection/Test	**Action**
DEFINITION: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. • Remove and inspect the air filter element for dirt or for restrictions. Replace as necessary.
Sensor/System	• Inspect the crankcase ventilation valve for proper operation. Place a finger over the inlet hole of the valve end several times. The valve should snap back. If not, replace the valve. Refer to Crankcase Ventilation System Description. • Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity.

Rough, Unstable, or Incorrect Idle and Stalling	
Inspection/Test	**Action**
Fuel System	• Inspect the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Inspect that each fuel injector harness is connected to the correct injector/cylinder. Relocate fuel injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the heated oxygen sensor (HO2S) connector – Engine oil contaminated by fuel – An evaporative emission (EVAP) canister purge condition – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Leaking fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate mass air flow (MAF) sensor – Blockage on the inlet screen of the MAF sensor--Refer to Manifold Absolute Pressure Sensor Replacement. – Vacuum hoses that are split, kinked, or improperly connected – An air intake duct that is collapsed or restricted – An air filter that is dirty or restricted. • Inspect for the following conditions that may cause the engine to run lean: **NOTICE:** *Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.* – Water intrusion in the HO2S connector – An exhaust leak between the HO2S and the engine – Vacuum leaks – Incorrect fuel pressure--Refer to Fuel System Diagnosis. – Restricted fuel injectors--Refer to Fuel System Diagnosis. – An inaccurate MAF sensor – Fuel contamination--Refer to Alcohol/Contaminants-in-Fuel Diagnosis. – Vacuum hoses that are split, kinked, or improperly connected

Rough, Unstable, or Incorrect Idle and Stalling	
Inspection/Test	**Action**
Ignition System	• Inspect for proper ignition voltage output with the J 26792 Spark Tester. Refer to Electronic Ignition (EI) System Diagnosis for procedure. • Remove spark plugs and check for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • An improper spark plug gap will cause a driveability problem. Refer to Spark Plug Inspection. Gap the spark plugs using a wire gage gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. • Visually and physically inspect secondary ignition for the following conditions: – Ignition wires arcing to ground – Ignition wires for proper routing • Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.

Rough, Unstable, or Incorrect Idle and Stalling	
Inspection/Test	**Action**
Engine Mechanical	• Inspect engine mechanical for the following conditions: – Compression – Sticking or leaking valves – Worn camshaft lobes – Valve timing – Bent push rods – Worn rocker arms – Broken valve springs – Excessive oil in combustion chamber or leaking valve seals. • For incorrect basic engine parts. Inspect the following: – The camshaft – The cylinder heads – The pistons, etc.
Additional Inspections	• Inspect the exhaust system for possible restrictions. Inspect for the following: – Inspect the exhaust system for damaged or collapsed pipes. – Inspect the mufflers for heat distress or possible internal failure. – Inspect for possible plugged three-way catalytic converters by comparing exhaust system back pressure on each side of engine. Inspect the back pressure by removing secondary air injection (AIR) check valves near exhaust manifolds. Refer to Restricted Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change indicates that EMI is present. If a problem exists, inspect routing of secondary ignition wires or high voltage components near the ignition control circuits. • Inspect the park neutral position (PNP) switch circuit. • Inspect for faulty motor mounts. • Inspect the intake manifold and the exhaust manifold passages for casting flash.

Dieseling, Run-On

Dieseling, Run-On	
Inspection/Test	**Action**
DEFINITION: Engine continues to run after key is turned OFF, but runs very rough. If the engine runs smooth, inspect the ignition switch and the ignition switch adjustment.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations.
Fuel System	Inspect the fuel injectors for a leaking condition. Refer to Fuel System Diagnosis for the proper procedure.

Backfire

Backfire	
Inspection/Test	**Action**
DEFINITION: Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls. • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations.
Sensor/System	• Inspect the air intake system and crankcase for air leaks. • Inspect for an inaccurate speedometer. • Monitor the knock sensor (KS) system for excessive spark retard activity with a scan tool. Refer to Knock Sensor (KS) System Description.
Fuel System	• Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis. • Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis. • Inspect the fuel injectors. Refer to Fuel Injector Solenoid Coil Test. • Verify that each injector harness is connected to the correct injector or cylinder. Relocate injector harnesses as necessary.

Backfire	
Inspection/Test	**Action**
Ignition System	• Inspect for proper ignition voltage output with the J 26792 Spark Tester. • Remove spark plugs and inspect for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits – Refer to Spark Plug Inspection. • An improper spark plug gap will cause a driveability condition. Refer to Spark Plug Inspection. Gap the spark plugs using a wire gage gap tool. Refer to Spark Plug Replacement. • Determine the cause of the fouling before replacing the spark plugs. Refer to Spark Plug Inspection for diagnosis. • Visually and physically inspect secondary ignition for the following conditions: – Ignition wires arcing to ground – Ignition coils arcing to ground • Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300. • Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis.
Engine Cooling System	• Inspect the engine coolant level for being low. Refer to Loss of Coolant. • Inspect the engine thermostat for proper operation and for the correct heat range. Refer to Thermostat Diagnosis.

Backfire	
Inspection/Test	**Action**
Engine Mechanical	• Inspect engine mechanical for the following conditions: – Compression – Sticking or leaking valves – Worn camshaft lobes – Valve timing – Bent push rods – Worn rocker arms – Broken valve springs – Excessive oil in combustion chamber or leaking valve seals. • For incorrect basic engine parts. Inspect the following: – The camshaft – The cylinder heads – The pistons, etc.
Additional Inspections	• Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label. • Inspect the intake manifold and the exhaust manifold passages for casting flash. • Inspect the transmission torque converter clutch (TCC) operation. The scan tool should indicate an RPM drop when the TCC is commanded ON. Refer to Torque Converter Diagnosis for the 4L60-E/4L65-E transmission or Torque Converter Diagnosis. • Inspect the exhaust system for possible restrictions. Inspect the following: – The exhaust system for damaged or collapsed pipes – The mufflers for heat distress or possible internal failure – Possible plugged 3-way catalytic converters by comparing exhaust system back pressure on each side of engine--Inspect back pressure by removing AIR check valves near exhaust manifolds. Refer to Restricted Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change may indicate that EMI is present. If a condition exists, inspect for high voltage components near the ignition control circuits. • Inspect the park/neutral position (PNP) switch operation. • Inspect for faulty motor mounts. • Inspect the intake manifold and the exhaust manifold passages for casting flash.

Malfunction Indicator Lamp (MIL) Diagnosis

Diagnostic Fault Information

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

Circuit/System Description

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

Reference Information

Schematic Reference

- Instrument Cluster Schematics
- Engine Controls Schematics

Connector End View Reference

- Displays and Gages Connector End Views
- Powertrain Control Module Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Output Controls
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, the MIL should turn ON and OFF when commanded with a scan tool.

Circuit/System Testing

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

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Control Module References
- Instrument Cluster Replacement

Engine Cranks but Does Not Run

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

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

Engine Cranks but Does Not Run				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *DO NOT allow the ignition switch to be interrupted during this step.* Crank the engine for the specified amount of time. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 3
3	Does the scan tool display any body control module (BCM) vehicle theft deterrent (VTD) DTCs?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Probe both test points of the PCM 1 fuse located in the underhood fuse block, with a test lamp connected to a good ground. Does the test lamp illuminate on at least one test point of the fuse	—	Go to Step 5	Go to Ignition Relay Diagnosis
5	1. Turn OFF the ignition. 2. Disconnect the spark plug wire from the spark plug. 3. Install the J 26792 Spark Tester to the spark plug wire. 4. Attach the clamp end of the spark tester to a good engine ground. 5. Observe the spark tester. 6. Crank the engine. 7. Repeat the test for the remaining cylinders. 8. Does the spark tester produce a spark on all cylinders?	—	Go to Step 6	Go to Electronic Ignition (EI) System Diagnosis
6	Monitor the ignition 1 signal parameter with a scan tool. Is the ignition 1 signal parameter at the specified value?	B+	Go to Step 7	Go to Step 10

Engine Cranks but Does Not Run				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Command the fuel pump ON with a scan tool. Does the fuel pump operate?	—	Go to Step 8	Go to Fuel Pump Electrical Circuit Diagnosis
8	1. Turn OFF the ignition. 2. Install a fuel pressure gage. Refer to Fuel System Diagnosis. **IMPORTANT:** *The fuel pump operates for about 2 seconds when the ignition is turned ON. The fuel pressure must be observed when the fuel pump is operating.* 3. Turn ON the ignition, with the engine OFF. 4. Observe the fuel pressure while the fuel pump is operating. Is the fuel pressure within the specified range?	385-425 kPa (55-62 psi)	Go to Step 9	Go to Fuel System Diagnosis

Engine Cranks but Does Not Run				
Step	**Action**	**Value(s)**	**Yes**	**No**
9	Inspect for the following conditions: • The engine coolant temperature (ECT) sensor is not close to the actual engine temperature. • The duct work between the mass air flow (MAF) sensor and the throttle body for air leaks • A restricted exhaust system--Refer to Restricted Exhaust. • A malfunctioning MAF sensor may cause a no start or a stall after a start. If you suspect this, disconnect the MAF sensor. The powertrain control module (PCM) will default to the speed density in order to calculate the engine load and the intake air flow. If disconnecting the MAF sensor corrects the condition and the connections are OK. Refer to DTC P0102. • The spark plugs for being gas fouled--Refer to Spark Plug Inspection. • An engine mechanical failure that causes an engine not to start such as timing chain, low compression. • Compare the MAP/BARO parameters to another vehicle. The parameter values should be close to each other. Did you complete the action?	—	Go to Step 13	—
10	1. Test the ignition 1 voltage circuit for an open or for a short to ground. Refer to Circuit Testing and Wiring Repairs. 2. Replace the fuse if necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12

Engine Cranks but Does Not Run				
Step	**Action**	**Value(s)**	**Yes**	**No**
12	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. 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. Attempt to start the engine. Does the engine start the continue to run?	—	Go to Step 14	Go to Step 2
	1. Allow the engine to reach operating temperature. 2. Observe the DTC information with a scan tool. Are there any DTCs that have not been diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

Ignition Relay Diagnosis

Circuit Description

The ignition relay is a normally open relay. The relay armature is held in the open position by spring tension. When the ignition switch is turned to the run or start position, current will flow through the relay coil. A wire connected to the other end of the relay coil completes the path to ground. The electomagnetic field created by the relay coil, overcomes the spring tension and moves the armature allowing the relay contacts to close. The closed relay contacts allow current to flow from the battery to the following fuses:

- The PCM 1 fuse
- The ETC/ECM fuse
- The INJ 1 fuse
- The INJ 2 fuse

When the ignition switch is turned to the OFF position, the electromagnetic field collapses. This action allows the spring tension to move the armature away from the relay contacts, which interrupts current flow to the fuses.

If the ignition relay fails to close, the engine will crank, but will not run. The class 2 communications will be available with the use of a scan tool.

The ignition relay table assumes that the vehicle battery is fully charged.

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Turn ON the ignition, with the engine OFF. 2. Remove the underhood junction block cover. 3. Probe the following fuses with a test lamp that is connected to a good ground: • The PCM 1 fuse • The ETC/ECM fuse • The INJ 1 fuse • The INJ 2 fuse Does the test lamp illuminate on at least one test point of each fuse?	—	Go to Step 3	Go to Step 10
3	1. Turn OFF the ignition. 2. Probe both test points of the PCM 1 fuse with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate on either test point of the fuse?	—	Go to Step 4	Go to Step 30

Ignition Relay Diagnosis

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Remove the ignition relay from the underhood junction block with the J 43244 Relay Puller Pliers. **NOTICE:** *Refer to Test Probe Notice in Cautions and Notices.* 3. Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5
5	Test the relay load bus bar of the underhood junction block between the ignition relay and the fuses to the circuit components for a short to battery positive voltage. Refer to Circuit Testing. Did you find a condition?	—	Go to Step 29	Go to Step 6
6	1. Turn OFF the ignition. 2. Remove the following fuses from the underhood junction block: • The PCM 1 fuse • The ETC/ECM fuse • The INJ 1 fuse • The INJ 2 fuse 3. Probe the above fuse terminals in the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate at any of the fuse terminals?	—	Go to Diagnostic System Check - Vehicle	Go to Step 27

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. 3. Disconnect the underhood junction block electrical connector that contains the ignition 1 voltage circuit for the ignition relay. 4. Disconnect the ignition switch electrical connector that contains the ignition 1 voltage circuit for the ignition relay. 5. Connect the negative battery cable to the battery. 6. Test the ignition 1 voltage circuit for a short to battery positive voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 8
8	1. Turn OFF the ignition. 2. Probe the ignition 1 voltage terminal on the ignition switch side of the ignition switch electrical connector with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 28	Go to Step 9
9	Test the ignition 1 voltage bus bar circuit in the underhood junction block for a short to battery positive voltage. Refer to Circuit Testing Did you find a condition?	—	Go to Step 29	Go to Step 27
10	1. Turn OFF the ignition. 2. Inspect the 40-amp IGN B fuse in the underhood junction block. Refer to Circuit Protection - Fuses. Is the fuse open?	—	Go to Step 11	Go to Step 18

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Remove the 40-amp IGN B fuse from the underhood junction block. **NOTICE:** *Refer to Test Probe Notice in Cautions and Notices.* 2. Probe both fuse terminals in the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate on at least one fuse terminal?	—	Go to Step 12	Go to Step 17
12	Test the ignition 1 voltage circuit between the ignition switch and the underhood junction block for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 13
13	Test the ignition switch assembly for a short to ground. Refer to Circuit Testing. Did you find a condition?	—	Go to Step 28	Go to Step 14
14	Test the battery positive voltage circuit between the underhood junction block and the ignition switch for a short to ground. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 15
15	Test the battery positive voltage bus bar circuit of the underhood junction block between the 40-amp IGN B fuse and the ignition switch for a short to ground. Did you find a condition?	—	Go to Step 29	Go to Step 16

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
16	Test the ignition 1 voltage bus bar circuit of the underhood junction block that contains the ignition relay for a short to ground. Did you find a condition?	—	Go to Step 29	Go to Step 27
17	1. Turn OFF the ignition. 2. Probe the mounting stud for the battery positive cable at the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 29	Go to Diagnostic System Check - Vehicle.
18	1. Turn OFF the ignition. 2. Remove the ignition relay with the J 43244 from the underhood junction block. **NOTICE:** *Refer to Test Probe Notice in Cautions and Notices.* 3. Probe the battery positive voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 19	Go to Step 29
19	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 23	Go to Step 20

Ignition Relay Diagnosis

Step	Action	Value(s)	Yes	No
20	1. Turn OFF the ignition. 2. Test the ignition 1 voltage circuit between the ignition switch and the underhood junction block for a high resistance or for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 21
21	Test the ignition switch assembly for a high resistance or for an open. Refer to Circuit Testing. Did you find a condition?	—	Go to Step 28	Go to Step 22
22	Test the battery positive voltage circuit between the ignition switch and the underhood junction block for a high resistance or for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
23	1. Turn ON the ignition, with the engine OFF. 2. Probe the coil ground circuit of the ignition relay at the underhood junction block with a test lamp that is connected to battery voltage. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate?	—	Go to Step 25	Go to Step 24

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
24	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. 3. Disconnect the underhood junction block electrical connectors. 4. Test the coil ground circuit of the ignition relay at the underhood junction block electrical connector for a high resistance or for an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
25	1. Turn OFF the ignition. 2. Jumper the ignition relay battery positive voltage circuit and the ignition relay load circuit together at the underhood junction block with a 20-amp fused jumper wire. Refer to Using Fused Jumper Wires. 3. Probe the following fuses with a test lamp that is connected to a good ground: • PCM 1 • ETC/ECM • INJ 1 • INJ 2 • Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp. Does the test lamp illuminate on at least one test point of each fuse?	—	Go to Step 26	Go to Step 29

Ignition Relay Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
26	Test for an intermittent and for a poor connection at the underhood junction block, ignition relay connector location. Refer to Testing for Intermittent Conditions and Poor Connections. Did you find a condition?	—	Go to Step 29	Go to Step 27
27	Replace the ignition relay. Did you complete the replacement?	—	Go to Step 30	—
28	Replace the ignition switch. Refer to Ignition and Start Switch Replacement. Did you complete the replacement?	—	Go to Step 30	—
29	Replace the underhood electrical center. Did you complete the replacement?	—	Go to Step 30	—
30	1. Replace any open fuses. 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and run?	—	Go to Step 31	Go to Engine Cranks
31	1. Clear the DTCs with a scan tool. 2. Operate the vehicle for 5 minutes. Does a DTC set during this ignition cycle?	—	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

Fuel Pump Electrical Circuit Diagnosis

Circuit Description

When the ignition is turned ON, the powertrain control module (PCM) will turn ON the in-tank fuel pump. The in-tank fuel pump will remain ON as long as the engine is cranking or running and the PCM is receiving reference pulses. If there are no reference pulses, the PCM will turn the in-tank fuel pump OFF 2 seconds after the ignition is turned ON or 2 seconds after the engine stops running.

Diagnostic Aids

A fuel pump prime terminal is available at the underhood bussed electrical center (UBEC). Refer to the UBEC cover for terminal location.

The following conditions may have caused the fuel pump fuse to open:

- The fuse is faulty.
- There is an intermittent short in the fuel pump power feed circuit.
- The fuel pump has an intermittent internal problem.

For an intermittent condition, refer to Testing for Intermittent Conditions and Poor Connections.

Test Description

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

2. Command both the ON and OFF states. Repeat the commands as necessary.
3. This step determines if the condition is located on the coil side or the switch side of the circuit.
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 determines if a voltage is constantly being applied to the fuel pump relay.
12. To gain access to the fuel pump connector, the fuel tank may need to be removed.
13. This step determines if the condition with the circuit is intermittent. If the fuse does not open, inspect the supply voltage circuit between the fuse and the fuel pump for an intermittent condition.
15. Use the same amperage fuse in the jumper as is used to protect the fuel pump circuit.
16. To gain access to the fuel pump connector, the fuel tank may need to be removed.
17. Inspect the ground connection for the fuel pump. Be certain all ground connections are clean and tight.

Fuel Pump Electrical Circuit Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump turn ON and OFF?	—	Go to Diagnostic Aids	Go to Step 3
3	Command the fuel pump relay ON and OFF with a scan tool. Do you hear a click when you command the fuel pump relay ON and OFF?	—	Go to Step 9	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. 5. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	—	Go to Step 5	Go to Step 6
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	—	Go to Step 19	Go to Step 22
6	Does the test lamp remain illuminated with each command?	—	Go to Step 7	Go to Step 8

Fuel Pump Electrical Circuit Diagnosis

Step	Action	Value(s)	Yes	No
7	Test the control circuit of the fuel pump relay for a short to voltage. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 26
8	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 20
9	Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	—	Go to Step 10	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	—	Go to Step 21	Go to Step 25
11	Is the fuel pump fuse open?	—	Go to Step 12	Go to Step 14
12	1. Test the supply voltage circuit of the fuel pump for a grounded circuit between the fuel pump fuse and the fuel pump. Refer to Circuit Testing and Wiring Repairs. 2. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	—	Go to Step 27	Go to Step 13
13	1. Install all disconnected electrical components. 2. Install a new fuel pump fuse. 3. Turn ON the fuel pump with a scan tool. Is the fuel pump fuse open?	—	Go to Step 24	Go to Testing for Intermittent Conditions and Poor Connections

Fuel Pump Electrical Circuit Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
14	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the fuel pump relay switch with a test lamp that is connected to a good ground. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 23
15	Connect a 20-amp fused jumper wire between the battery voltage circuit of the fuel pump relay switch and the supply voltage circuit of the fuel pump. Does the fuel pump operate	—	Go to Step 19	Go to Step 16
16	Test the supply voltage circuit of the fuel pump for an open or high resistance between the fuel pump relay and the fuel pump. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 17
17	**IMPORTANT:** *Inspect the ground circuit for being tight, corrosion on terminals, or damage to the wiring harness* Test the ground circuit of the fuel pump for an open or high resistance. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 18
18	Inspect for poor connections at the fuel pump. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 24

Fuel Pump Electrical Circuit Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
19	Inspect for poor connections at fuel pump relay. Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 25
20	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Circuit Testing and Wiring Repairs. Did you find and correct the condition?	—	Go to Step 27	Go to Step 26
21	Repair the supply voltage circuit of the fuel pump for a short to voltage. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 27	—
22	Repair the open fuel pump relay ground circuit. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 27	—
23	Repair the battery voltage circuit of the fuel pump relay switch. Refer to Wiring Repairs. Did you complete the repair?	—	Go to Step 27	—
24	**IMPORTANT:** *Inspect for poor connections at the fuel pump, within the fuel tank, before replacing the fuel pump.* 1. Replace the fuel pump. Refer to Fuel Sender Assembly Replacement. 2. Replace the fuel pump fuse if necessary. Did you complete the replacement?	—	Go to Step 27	—

Fuel Pump Electrical Circuit Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
25	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 27	—
26	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	—	Go to Step 27	—
27	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 2

Fuel System Diagnosis

System Description

The powertrain control module (PCM) enables the fuel pump relay when the ignition switch is turned ON. The PCM will disable the fuel pump relay within 2 seconds unless the PCM detects ignition reference pulses. The PCM continues to enable the fuel pump relay as long as ignition reference pulses are detected. The PCM disables the fuel pump relay within 2 seconds if ignition reference pulses cease to be detected and the ignition remains ON.

The Fuel System is a returnless on-demand design. The fuel pressure regulator is a part of the fuel sender assembly, eliminating the need for a return pipe from the engine. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

The fuel tank stores the fuel supply. An electric turbine style fuel pump attaches to the fuel sender assembly inside the fuel tank. The fuel pump supplies high pressure fuel through the fuel filter and the fuel feed pipe to the fuel injection system. The fuel pump provides fuel at a higher rate of flow than is needed by the fuel injection system. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel sender assembly. The function of the venturi pump is to fill the fuel sender assembly reservoir. The fuel pressure regulator, a part of the fuel sender assembly, maintains the correct fuel pressure to the fuel injection system. The fuel pump and sender assembly contains a reverse flow check valve. The check valve and the fuel pressure regulator maintain fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

Test Description

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

2. This step verifies that the fuel pump is operating.
4. This step tests for an internal fuel leak. If the fuel pressure drops during this test, then an internal loss of pressure is indicated.
7. This step tests for a loss of fuel pressure between the fuel feed pipe shut-off adapter and the fuel pump.
10. This step verifies that a circuit condition is not the cause of a fuel pressure concern. Inspect all fuel pump electrical circuits thoroughly.
11. This step tests for a leaking fuel injector, or fuel pressure regulator. If the fuel pressure remains constant during this test, the fuel injectors are not leaking fuel.

Fuel System Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	**IMPORTANT:** *Inspect the fuel system for damage, or external leaks, before proceeding with this diagnostic.* Turn ON the ignition, with the engine OFF. Command the fuel pump ON with a scan tool. Does the fuel pump operate?	—	Go to Step 3	Go to Fuel Pump Electrical Circuit Diagnosis

Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
3	**IMPORTANT:** *Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic.* 1. Turn OFF the ignition. 2. Turn OFF all accessories. **CAUTION:** ***Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gage. Place the towel in an approved container when the connection of the fuel pressure gage is complete.*** 3. Install the J 34730-1A Fuel Pressure Gage. 4. Place the bleed hose of the fuel pressure gage into an approved gasoline container. 5. Turn ON the ignition, with the engine OFF. 6. Command the fuel pump ON with a scan tool. 7. Bleed the air out of the fuel pressure gage. **IMPORTANT:** • *It may be necessary to command the fuel pump ON several times in order to obtain the highest possible fuel pressure.* • *DO NOT start the engine.* 8. Command the fuel pump ON with a scan tool. Observe the fuel pressure gage, with the fuel pump commanded ON. Is the fuel pressure within the specified value?	384-425 kPa (56-62 psi)	Go to Step 4	Go to Step 8

Fuel System Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
4	**IMPORTANT:** *The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.* Observe the fuel pressure gage for 1 minute. Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to Step 7	Go to Step 5
5	1. Relieve the fuel pressure to the first specified value. 2. Observe the fuel pressure gage for 5 minutes. Does the fuel drop more than the second specified value?	69 kPa (10 psi) 14 kPa (2 psi)	Go to Step 12	Go to Step 6
6	1. Operate the vehicle within the conditions of the customer concern. 2. Observe the fuel related parameters with a scan tool. Do any of the scan tool parameters indicate a lean condition?	—	Go to Step 9	Go to Symptoms - Engine Controls

Fuel System Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to Fuel Pressure Relief. 3. Disconnect the fuel feed hose from the fuel rail pipe. 4. Install the J 37287 Fuel Line Shut-Off Adaptor between the fuel hoses and the fuel rail pipe. 5. Open the valve on the fuel pipe shut-off adapter. 6. Turn ON the ignition, with the engine OFF. 7. Command the fuel pump ON with a scan tool. 8. Bleed the air from the fuel pressure gage. 9. Command the fuel pump ON and then OFF with a scan tool. 10. Close the fuel feed pipe shut-off valve. 11. Observe the fuel pressure gage for 1 minute. Does the fuel pressure remain constant?	—	Go to Step 12	Go to Step 11
8	Is the fuel pressure more than the specified value?	427 kPa (62 psi)	Go to Step 12	Go to Step 9
9	Inspect the fuel feed pipe for a restriction. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
10	Inspect the harness connectors and ground circuits of the fuel pump for poor connections. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12

Fuel System Diagnosis				
Step	**Action**	**Value(s)**	**Yes**	**No**
11	1. Turn OFF the ignition. 2. Raise the fuel rail, with the fuel lines connected. Refer to Fuel Rail Assembly Replacement. 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump ON with a scan tool. 5. Locate and replace the leaking fuel injector. Refer to Fuel Injector Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the fuel pump. Refer to Fuel Sender Assembly Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 3

Fuel Injector Solenoid Coil Test

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied directly to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. A fuel injector coil winding resistance that is too high or too low will affect engine driveability. A fuel injector control circuit DTC may not set, but a misfire may be apparent. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

Diagnostic Aids

- The use of Dielectric compound GM P/N 12377900 (Canadian P/N 10953529) in the fuel injector electrical connector may eliminate a corrosion condition.
- Monitoring the misfire current counters, or misfire graph, may help isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.
- Perform the fuel injector coil test within the conditions of the customers concern. A fuel injector condition may only be apparent at a certain temperature, or under certain conditions.
- If the fuel injector coil test does not isolate the condition perform the fuel injector balance test. Refer to Fuel Injector Balance Test with Special Tool or Fuel Injector Balance Test with Tech 2.

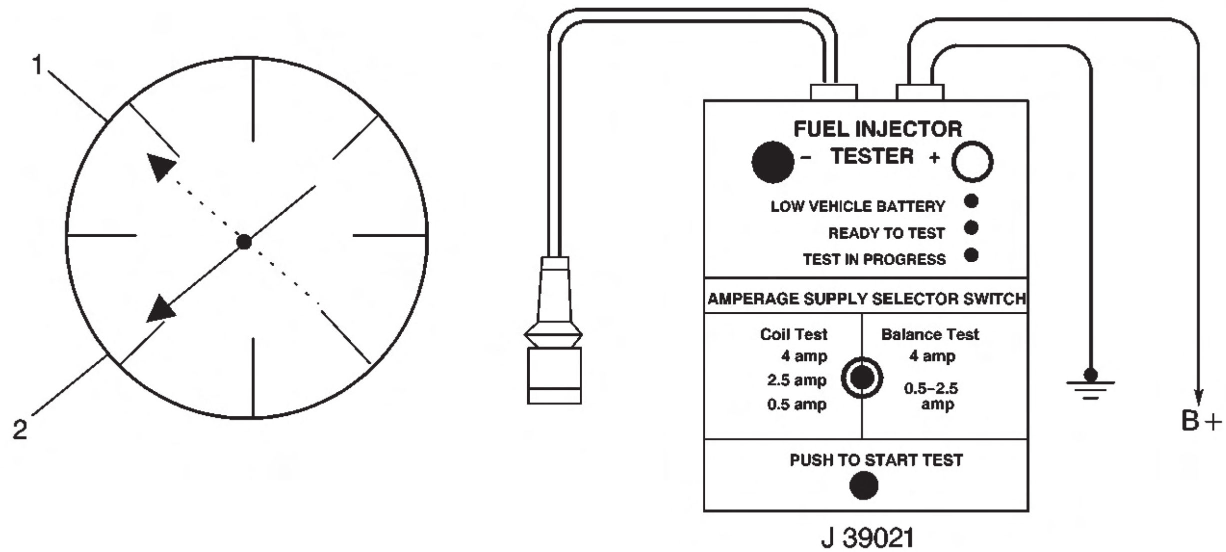
Fuel Injector Solenoid Coil Test				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter within the specified range?	10-32°C (50-90°F)	Go to Step 3	Go to Step 4
3	Measure the resistance of each fuel injector with a DMM. Refer to Testing for Continuity . Do any of the fuel injectors display a resistance outside the specified range?	11-14 ohms	Go to Step 6	Go to Diagnostic Aids
4	1. Measure the resistance of each fuel injector with a DMM. Refer to Testing for Continuity . 2. Record each fuel injector value. 3. Subtract the lowest resistance value from the highest resistance value. Is the difference equal to, or less than, the specified value?	3 ohms	Go to Fuel Injector Balance Test with Special Tool or Fuel Injector Balance Test with Tech 2	Go to Step 5

Fuel Injector Solenoid Coil Test				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	1. Add all of the fuel injector resistance values, to obtain a total resistance value. 2. Divide the total resistance value by the number of fuel injectors, to obtain an average resistance value. 3. Subtract the lowest individual fuel injector resistance value from the average resistance value. 4. Compute the difference between the highest individual fuel injector resistance value and the average resistance value. 5. Replace the fuel injector that displays the greatest resistance difference, above or below the average. Refer to Fuel Injector Replacement . Did you complete the replacement?	—	Go to Step 7	—
6	Replace the fuel injector or fuel injectors that are out of the specified range. Refer to Fuel Injector Replacement . Did you complete the replacement?	11-14 ohms	Go to Step 7	—
7	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 2

Fuel Injector Balance Test with Special Tool

Description

The scan tool is first used to energize the fuel pump. The fuel injector tester is then used to pulse each injector for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector.



(1) First Fuel Pressure Gage Reading
(2) Second Fuel Pressure Gage Reading

Fuel Injector Balance Test Example (Typical)

Fuel Injector Balance Test Example (Typical)				
Cylinder	**1**	**2**	**3**	**4**
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop

Test Description

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

6. If the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading. Refer to the previous illustration.

Fuel Injector Balance Test with Special Tool				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Did you perform the Fuel Injector Coil Test?	—	Go to Step 3	Go to Fuel Injector Coil Test
3	**IMPORTANT:** *Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F).* Observe the ECT Sensor parameter with a scan tool. Is the ECT Sensor parameter less than the specified value?	94°C (201°F)	Go to Step 4	

<table>
<tr><th colspan="5">Fuel Injector Balance Test with Special Tool</th></tr>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>4</td><td>IMPORTANT:
Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic.

1. Turn OFF the ignition.
2. Install the fuel pressure gage. Refer to Fuel Pressure Gage Installation and Removal .
3. Turn ON the ignition, with the engine OFF.
4. Command the fuel pump ON with a scan tool.

IMPORTANT:
• You may need to command the fuel pump ON a few times in order to obtain the highest possible fuel pressure.
• Do not start the engine.

5. Observe the fuel pressure gage, with the fuel pump commanded ON.

Is the fuel pressure within the specified range?</td><td>385-425 kPa
(55-62 psi)</td><td>Go to Step 5</td><td>Go to Fuel System Diagnosis</td></tr>
<tr><td>5</td><td>IMPORTANT:
The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.

Monitor the fuel pressure gage for 1 minute.

Does the fuel pressure drop more than the specified value?</td><td>34 kPa
(5 psi)</td><td>Go to Fuel System Diagnosis</td><td>Go to Step 6</td></tr>
</table>

Fuel Injector Balance Test with Special Tool				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	**NOTICE** *Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.* **IMPORTANT:** *Refer to the illustration in the supporting text when performing the following steps.* 1. Connect the J 39021 Fuel Injector Coil and Balance Tester and the J 39021-380 Fuel Injector Test Harness to a fuel injector. 2. Set the amperage supply selector switch on the fuel injector tester to the Balance Test 0.5-2.5 amp position. 3. Command the fuel pump ON and OFF with a scan tool. 4. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. This is the first pressure reading. **IMPORTANT:** *Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value.* 5. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gage. This is the second fuel pressure reading. 7. Repeat steps 1-6 for each fuel injector. 8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is more than the average pressure drop or less than the average pressure drop by the specified value?	20 kPa (3 psi)	Go to Step 7	Go to Symptoms - Engine Controls

Fuel Injector Balance Test with Special Tool				
Step	**Action**	**Value(s)**	**Yes**	**No**
7	Clean the fuel injectors. Refer to Fuel Injector Cleaning Procedure . Did you complete the procedure?	—	Go to Step 8	—
8	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	—	Go to Symptoms - Engine Controls	System OK

Fuel Injector Balance Test with Tech 2

Description

The scan tool is first used to energize the fuel pump. The scan tool is then used to pulse each injector for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare the flow through each injector.

Fuel Injector Balance Test Example (Typical)				
Cylinder	**1**	**2**	**3**	**4**
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop

Fuel Injector Balance Test Example (Typical)

Fuel Injector Balance Test with Tech 2				
Step	**Action**	**Value(s)**	**Yes**	**No**
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Did you perform the Fuel Injector Coil Test?	—	Go to Step 3	Go to Fuel Injector Coil Test

Fuel Injector Balance Test with Tech 2				
Step	**Action**	**Value(s)**	**Yes**	**No**
3	**IMPORTANT:** • Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F). • Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic. 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the fuel pressure gage. Refer to Fuel Pressure Gage Installation and Removal . 4. Turn ON the ignition, with the engine OFF. 5. Command the fuel pump ON with a scan tool. **IMPORTANT:** • You may need to command the fuel pump ON a few times in order to obtain the highest possible fuel pressure. • Do not start the engine. 6. Observe the fuel pressure gage, with the fuel pump commanded ON. Is the fuel pressure within the specified value?	385-425 kPa (55-62 psi)	Go to Step 4	Go to Fuel System Diagnosis
4	**IMPORTANT:** *The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.* Observe the fuel pressure gage for 1 minute. Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to Fuel System Diagnosis	Go to Step 5

<table>
<tr><th colspan="5">Fuel Injector Balance Test with Tech 2</th></tr>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>5</td><td>NOTICE:
Refer to Fuel Injector Balance Test Notice in Cautions and Notices.

1. Select the Fuel Injector Balance Test function with a scan tool.
2. Select an injector to be tested.
3. Press Enter. This will prime the fuel system.
4. Record the fuel pressure indicated by the fuel pressure gage after the fuel pressure stabilizes. This is the 1st pressure reading.

IMPORTANT:
Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value.

5. Energize the fuel injector by depressing the Pulse Injector button on the scan tool. This will energize the injector and decrease the fuel pressure.
6. Record the fuel pressure indicated by the fuel pressure gage after the fuel injector has stopped pulsing. This is the 2nd pressure reading.
7. Press Enter again to bring you back to the Select Injector screen.
8. Repeat for each fuel injector.
9. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value.
10. Obtain a pressure drop value for each fuel injector.
11. Add all of the individual pressure drop values. This is the total pressure drop.
12. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop.

Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?</td><td>20 kPa (3 psi)</td><td>Go to Step 6</td><td>Go to Symptoms - Engine Controls</td></tr>
</table>

Fuel Injector Balance Test with Tech 2				
Step	**Action**	**Value(s)**	**Yes**	**No**
6	Clean the fuel injectors. Refer to Fuel Injector Cleaning Procedure. Did you complete the procedure?	—	Go to Step 7	—
7	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	—	Go to Symptoms - Engine Controls	System OK

Restricted Exhaust

Diagnostic Aids

CAUTION:

While engine is operating, the exhaust system will become extremely hot. To prevent burns avoid contacting a hot exhaust system.

Test Description

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

4. The exhaust system has very low back pressure under normal conditions. If the exhaust system is restricted, a significant increase in the exhaust pressure is noticed on the J 35314-A. Removing HO2S sensor may set a DTC. When finishing this diagnostic table, be sure to clear all codes.
5. This step will isolate the catalytic converter from the remainder of the exhaust system.
8. Confirming that the condition has been fixed is essential. If the symptom still exists and the vehicle has a dual exhaust system, proceed to Step 2 and repeat diagnostic procedure on the opposite exhaust pipe.

Restricted Exhaust				
Step	**Action**	**Value(s)**	**Yes**	**No**
1	Did you verify the customer complaint?	—	Go to Step 2	—
2	Did you review the exhaust symptoms diagnostic information and perform the necessary inspections?	—	Go to Step 3	Go to Symptoms - Engine Exhaust
3	1. Remove the heated oxygen sensor (HO2S) that is in front of and closest to the catalytic converter. 2. Install the J 35314-A Exhaust Back Pressure Gage in place of the HO2S sensor. 3. Start the engine. 4. Increase and monitor the engine speed at 2,000 RPM. Observe the exhaust system back pressure reading on the gage. Does the reading exceed the specified value?	20 kPa (3 psi) If equipped with a 4.8L or 6.0L - 3.4 kPa (0.5 psi)	Go to Step 4	Go to Step 7
4	1. Turn the engine off and place the ignition in the lock position. 2. Remove the J 35314-A. 3. Re-install the HO2S sensor. 4. Remove the post-catalyst HO2S sensor. 5. Install the J 35314-A in place of the post HO2S sensor. 6. Start the engine. 7. Increase and monitor the engine speed at 2,000 RPM. 8. Observe the exhaust system back pressure reading on the gage. Does the reading exceed the specified value?	20 kPa (3 psi) If equipped with a 4.8L or 6.0L 3.4 kPa (0.5 psi)	Go to Step 5	Go to Step 6

Restricted Exhaust				
Step	**Action**	**Value(s)**	**Yes**	**No**
5	Inspect the exhaust system for the following conditions: • *Damage in the exhaust pipe* • *Debris in the exhaust pipe* • *Muffler or resonator internal failure* • *Two-layer exhaust pipe separation* Did you find and correct the condition?	—	Go to Step 7	—
6	Replace the catalytic converter. Did you find and correct the condition?	—	Go to Step 7	—
7	1. Remove the J 35314-A. 2. Reinstall the 3. Clear any codes. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	—	System OK	Go To step 2

REPAIR INSTRUCTIONS

4.8L AND 6.0 L ENGINES

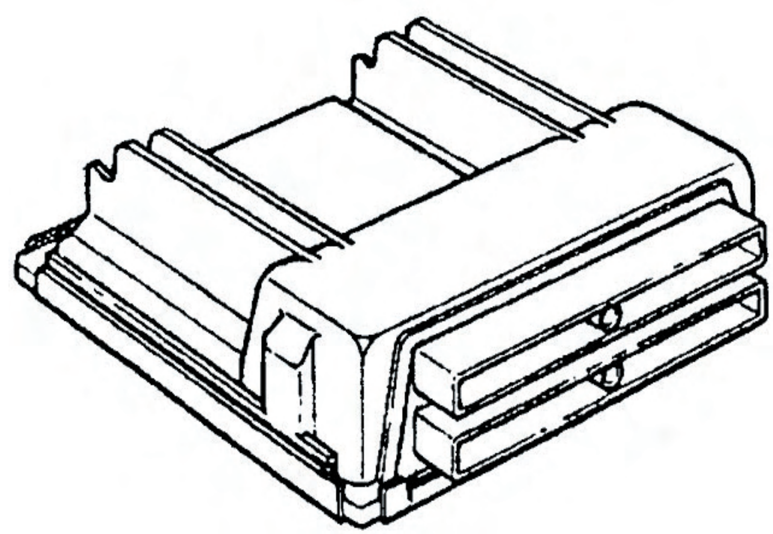
Powertrain Control Module Replacement

Service of the powertrain control module (PCM) should consist of either replacement of the PCM or programming of the electrically erasable programmable read only memory (EEPROM). If the diagnostic procedures call for the PCM to be replaced, the replacement PCM should be checked to ensure that the correct part is being used. If the correct part is being used, remove the faulty PCM and install the new service PCM.

NOTICE:

- *Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.*
- *Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.*
- *In order to prevent any possible electrostatic discharge damage to the control module, do no touch the connector pins or the soldered components on the circuit board.*
- *Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.*

Removal Procedure



1. Disconnect the negative battery cable.
2. Release the spring latch from the PCM.
3. Slide the PCM forward and rotate 90 degrees to access the PCM connectors.
4. Loosen the PCM electrical connector bolts.

NOTICE:
Do not touch the connector pins or soldered components on the circuit board in order to prevent possible electrostatic discharge (ESD) damage to the PCM.

NOTICE:
In order to prevent internal damage to the PCM, the ignition must be OFF when disconnecting or reconnecting the PCM connector.

5. Disconnect the PCM electrical connectors.
6. Release the PCM mounting tabs from the PCM.
7. Remove the PCM.

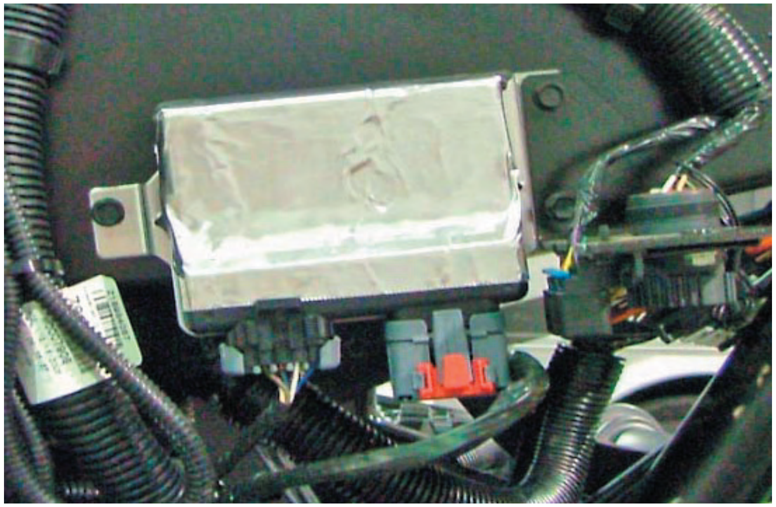
Installation Procedure

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

1. Connect the PCM electrical connectors.
2. Tighten the PCM electrical connector bolts to 8 N·m (71 lb in).
3. Position the PCM in the mounting tray and ensure that the mounting tabs are engaged.
4. Secure the spring latch to the PCM.
5. Connect the negative battery cable.

Throttle Actuator Control (TAC) Module Replacement

Removal Procedure



1. Disconnect the electrical connectors from the TAC module.
2. Remove the throttle actuator control (TAC) module nuts.
3. Remove the TAC module.

Installation Procedure

1. Install the TAC module.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the TAC module nuts and tighten the nuts to 1.9 N·m (17 lb in).
3. Install the TAC module connectors.

Crankshaft Position System Variation Learn

1. Install a scan tool.
2. Monitor the powertrain control module (PCM) for DTCs with a scan tool. If other DTCs are set, except DTC P0315, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC.
3. Select the crankshaft position variation learn procedure with a scan tool.
4. The scan tool instructs you to perform the following:
   4.1. Accelerate to wide open throttle (WOT).
   4.2. Release throttle when fuel cut-off occurs.
   4.3. Observe fuel cut-off for applicable engine.
   4.4. Engine should not accelerate beyond calibrated RPM value.
   4.5. Release throttle immediately if value is exceeded.
   4.6. Block drive wheels.
   4.7. Set parking brake.
   4.8. DO NOT apply brake pedal.
   4.9. Cycle ignition from OFF to ON.
   4.10. Apply and hold brake pedal.
   4.11. Start and idle engine.
   4.12. Turn the A/C OFF.
   4.13. Vehicle must remain in Park or Neutral.
   4.14. The scan tool monitors certain component signals to determine if all the conditions are met to continue with the procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool monitors the following components:
      - Crankshaft position (CKP) sensors activity--If there is a CKP sensor condition, refer to the applicable DTC.
      - Camshaft position (CMP) signal activity--If there is a CMP signal condition, refer to the applicable DTC.
      - Engine coolant temperature (ECT)--If the engine coolant temperature is not warm enough, idle the engine until the engine coolant temperature reaches the correct temperature.
5. Enable the CKP system variation learn procedure with the scan tool.

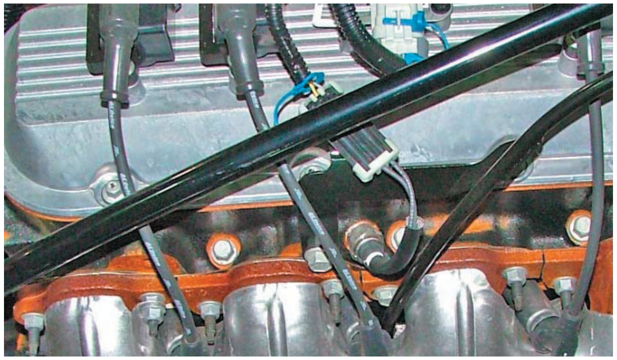
IMPORTANT:
While the learn procedure is in progress, release the throttle immediately when the engine starts to decelerate. The engine control is returned to the operator and the engine responds to throttle position after the learn procedure is complete.

6. Accelerate to WOT.
7. Release throttle when fuel cut-off occurs.
8. The scan tool display reads Test In Progress.
9. The scan tool displays Learn Status: Learned this ignition. If the scan tool indicates that DTC P0315 ran and passed, the CKP variation learn procedure is complete. If the scan tool indicates DTC P0315 failed or did not run, refer to DTC P0315. If any other DTCs set, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC.
10. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.
11. The CKP system variation learn procedure is also required when the following service procedures have been performed, regardless of whether or not DTC P0315 is set:
    - An engine replacement
    - A PCM replacement
    - A harmonic balancer replacement
    - A crankshaft replacement
    - A CKP sensor replacement
    - Any engine repairs which disturb the crankshaft to CKP sensor relationship.

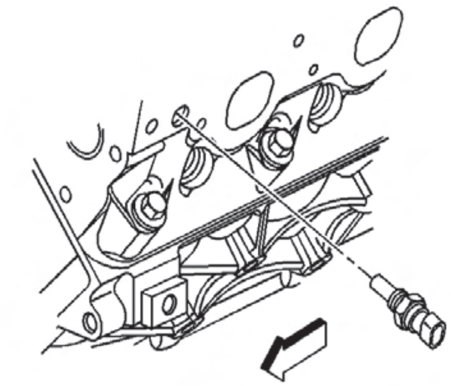
Engine Coolant Temperature (ECT) Sensor Replacement

Removal Procedure

NOTICE:
Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.



1. Drain the cooling system to a level below the engine cooling temperature (ECT) sensor.
2. Disconnect the ECT sensor electrical connector (5).



3. Remove the ECT sensor.

Installation Procedure

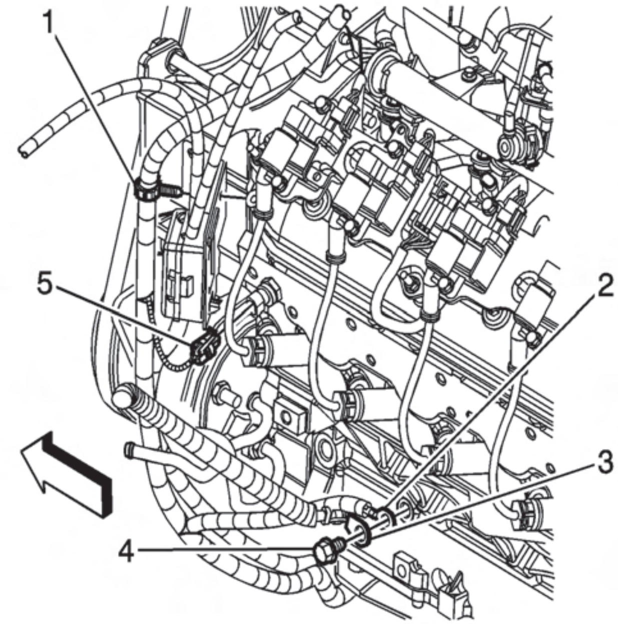
NOTICE:
Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

NOTICE:
Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.

1. If installing the old sensor, coat the threads with sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the ECT sensor and tighten the sensor to 20 N·m (15 lb ft).



3. Connect the ECT sensor electrical connector (5).
4. Refill the cooling.

Mass Airflow Sensor/Intake Air Temperature (MAF/IAT) Sensor Replacement

Removal Procedure

IMPORTANT:
Use care when handling the mass air flow (MAF)/ intake air temperature (IAT) sensor. Do not dent, puncture, or otherwise damage the honeycell located at the air inlet end of the MAF/IAT. Do not touch the sensing elements or allow anything including cleaning solvents and lubricants to come in contact with them. Use a small amount of a non-silicone based lubricant, on the air duct only, to aid in installation.

1. Disconnect the MAF/IAT sensor electrical connector.
2. Loosen the MAF/IAT clamp.
3. Disconnect the air duct from the MAF/IAT sensor.
4. Remove the MAF/IAT sensor from the air cleaner assembly.

Installation Procedure

IMPORTANT:
The embossed arrow on the MAF/IAT sensor indicates the proper air flow direction. The arrow must point toward the engine.

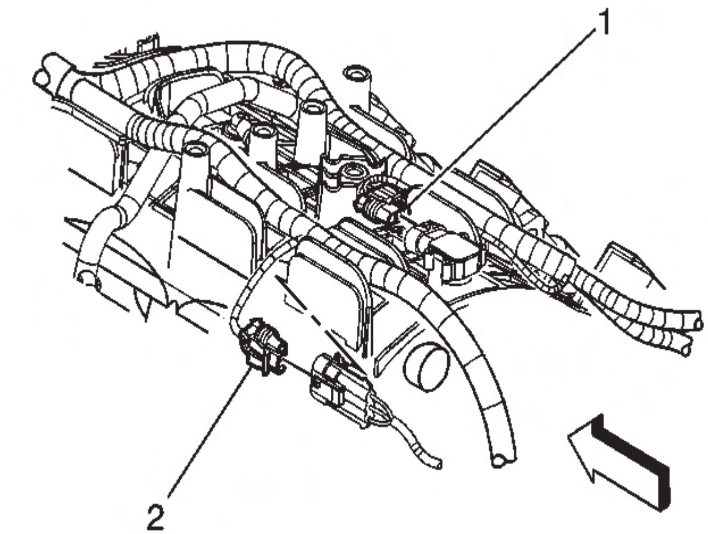
1. Locate the air flow direction arrow (2) on the MAF/IAT sensor.
2. Install the MAF/IAT sensor to the air cleaner assembly.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

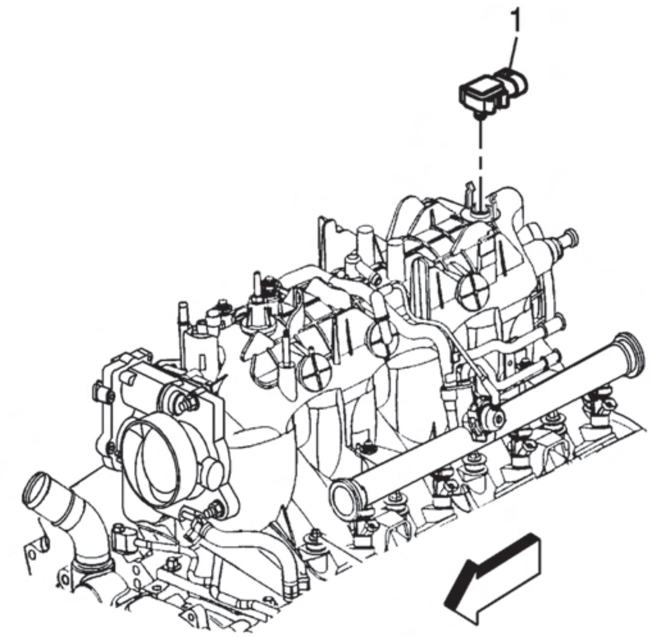
3. Tighten the MAF/IAT clamp to 7 N·m (62 lb in).
4. Connect the MAF/IAT sensor electrical connector.
5. Push in the gray CPA retainer.
6. Install the air cleaner outlet duct.

Manifold Absolute Pressure Sensor Replacement

Removal Procedure



1. Remove the engine sight shield.
2. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).



3. Remove the MAP sensor (1).

Installation Procedure

IMPORTANT:
Lightly coat the MAP sensor seal with clean engine oil before installing the sensor.

1. Install the MAP sensor (1).
2. Connect the MAP sensor electrical connector (1).
3. Install the engine sight shield.

Heated Oxygen Sensor Replacement

Removal Procedure

1. Raise and suitably support the vehicle.
2. Disconnect the connector position assurance (CPA) retainer.

NOTICE:
Do not remove the pigtail from either the heated oxygen sensor (HO2S). Removing the pigtail or the connector will affect sensor operation.

NOTICE
Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged.

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- *Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.*
- *Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.*
- *Ensure the sensor or vehicle lead wires are not bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead wire.*
- *Do not remove or defeat the oxygen sensor ground wire, where applicable. Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.*
- *Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.*

3. If the heated oxygen sensor (HO2S) pigtail or harness is attached to another component, disconnect the clip.
4. Disconnect the HO2S electrical connector.
5. Remove the HO2S.

Installation Procedure

IMPORTANT:
A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

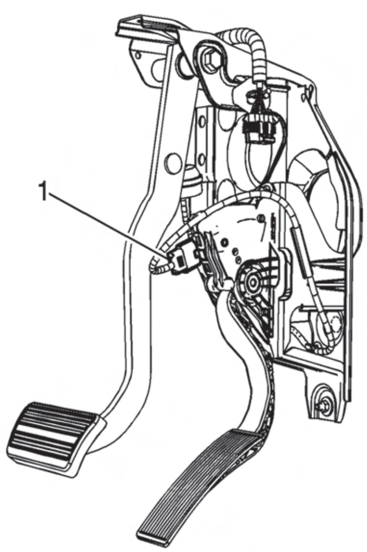
NOTICE:
Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

2. Install the HO2S and tighten to 42 N·m (31 lb ft).
3. Connect the HO2S electrical connector.
4. If the heated oxygen sensor (HO2S) pigtail or harness was attached to another component, connect the pigtail or harness of the new sensor to that component using the clip.
5. If necessary, bolt the front propeller shaft to the front differential.
6. Lower the vehicle.

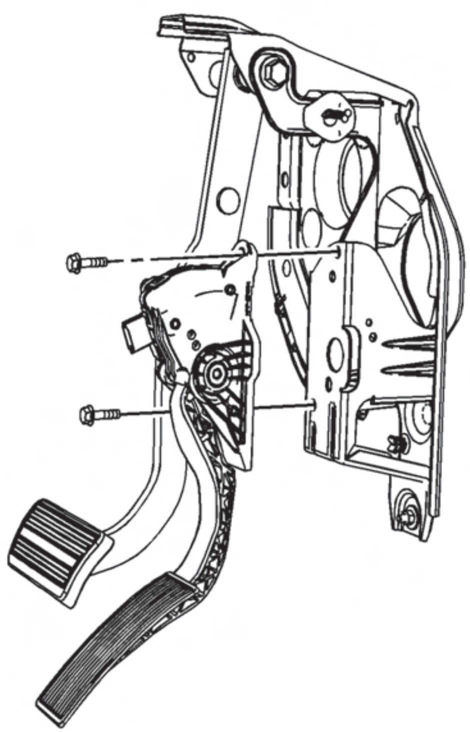
Accelerator Pedal Position Sensor Replacement

Removal Procedure

NOTICE:
Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.



1. Remove the connector position assurance (CPA) retainer.
2. Disconnect the accelerator pedal position (APP) sensor electrical connector (1).



3. Remove the accelerator pedal bolts.
4. Remove the accelerator pedal.

Installation Procedure

1. Position the accelerator pedal to the accelerator pedal bracket.

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

2. Install the accelerator pedal bolts and tighten the bolts to 9 N·m (80 lb in).
3. Connect the APP sensor electrical connector (1).
4. Install the CPA retainer.
5. Connect a scan tool to the diagnostic port in order to test for proper throttle-opening and throttle-closing range.
6. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
7. Verify that the vehicle meets the following conditions:
   - The vehicle is not in a reduced engine power mode.
   - The ignition is ON.
   - The engine is OFF.
8. Inspect the carpet fit under the accelerator pedal.

Throttle Body Assembly Replacement

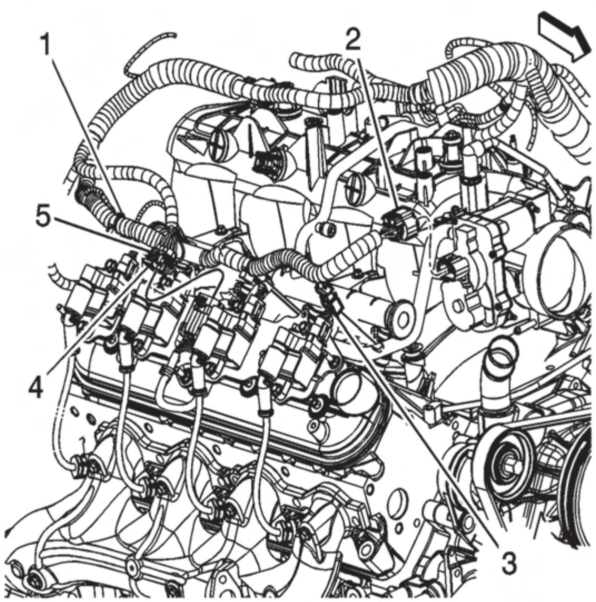
Removal Procedure

NOTICE:

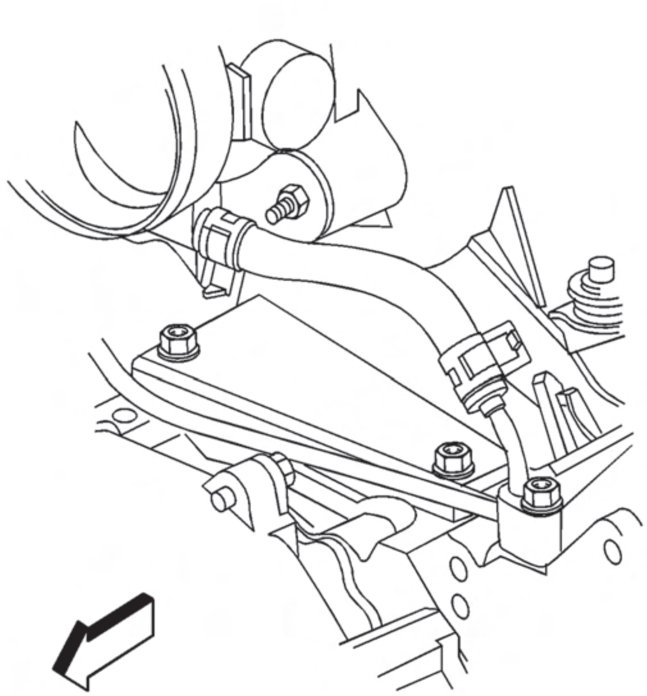
Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.

IMPORTANT:

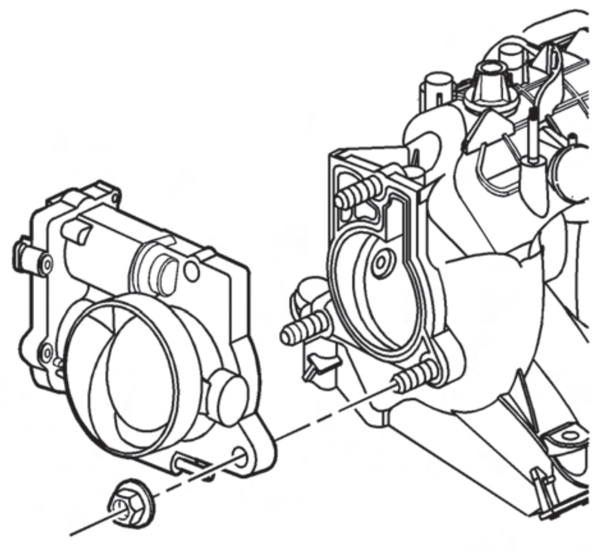
- *DO NOT for any reason, insert a screwdriver or other small hand tools into the throttle body to hold open the throttle plate, as the wedge inside the throttle body could be damaged.*
- *An 8-digit part identification number is stamped on the throttle body casting. Refer to this number if servicing, or part replacement is required.*



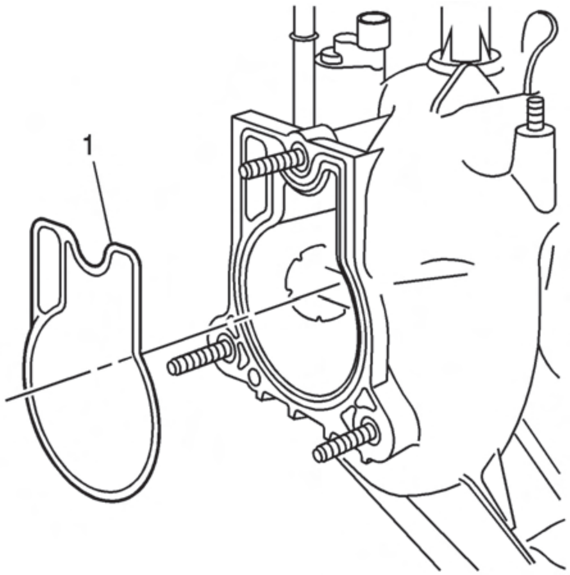
1. Partially drain the cooling system in order to allow the hose at the throttle body to be removed.
2. Remove the air cleaner outlet duct.
3. Remove the engine sight shield.
4. Disconnect the throttle actuator motor electrical connector (2).



5. Reposition the coolant air bleed hose clamp at the throttle body.
6. Remove the coolant air bleed hose from the throttle body.



7. Remove the throttle body nuts.
8. Remove the throttle body.



9. Remove and discard the throttle body gasket.

Installation Procedure

1. Install the NEW throttle body gasket.
2. Install the throttle body.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

3. Install the throttle body nuts and tighten the nuts to 10 N·m (89 lb in).
4. Install the coolant air bleed hose to the throttle body.
5. Position the coolant air bleed hose clamp at the throttle body.

IMPORTANT:
Verify that the throttle actuator motor harness connector and the connector seal are properly installed and not damaged.

6. Connect the throttle actuator motor electrical connector (2).
7. Install the engine sight shield.
8. Install the air cleaner outlet duct.
9. Refill the cooling system.

10. Connect a scan tool in order to test for proper throttle-opening and throttle-closing range.
11. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
12. Verify that the vehicle meets the following conditions:
    - The vehicle is not in a reduced engine power mode.
    - The ignition is ON.
    - The engine is OFF.
13. Start the engine.
14. Inspect for coolant leaks.

Throttle Body Cleaning

1. Remove the air cleaner intake duct.

CAUTION:

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

NOTICE:
Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

2. Inspect the throttle body bore and the throttle plate for deposits. You will need to open the throttle plate in order to inspect all surfaces.

NOTICE:
Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

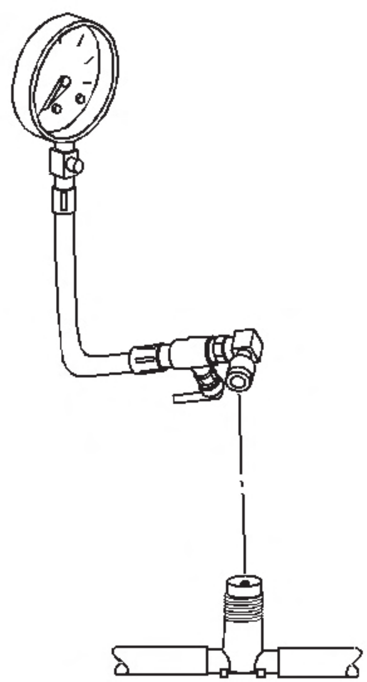
3. Clean the throttle body bore and the throttle plate using a clean shop towel with GM Top Engine Cleaner, P/N 1052626 or AC-Delco Carburetor Tune-Up Conditioner, P/N X66-P, or an equivalent product.
4. Install the air cleaner intake duct.

Fuel Pressure Relief

Tools Required
- J 34730-1A Fuel Pressure Gage
- J-34730-FF Fuel Pressure Gage

CAUTION:

Relieve the fuel system pressure before servicing fuel system components in order to reduce the risk of fire and personal injury. After relieving the system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. In order to reduce the chance of personal injury, cover the regulator and the fuel line fittings with a shop towel before disconnecting. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.



1. Disconnect the negative battery cable.
2. Install the J 34730-1A or the J-34730-FF. Refer to Fuel Pressure Gage Installation and Removal.
3. Loosen the fuel fill cap in order to relieve fuel tank vapor pressure.
4. Open the valve on the J 34730-1A or the J-34730-FF in order to bleed the system pressure. The fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gage into an approved container.
6. Once the system pressure is completely relieved, remove the J 34730-1A or the J-34730-FF.

Fuel Pressure Gage Installation and Removal

Installation Procedure

Tools Required

- J 34730-1A Fuel Pressure Gage
- J-34730-FF Fuel Pressure Gage

CAUTION:

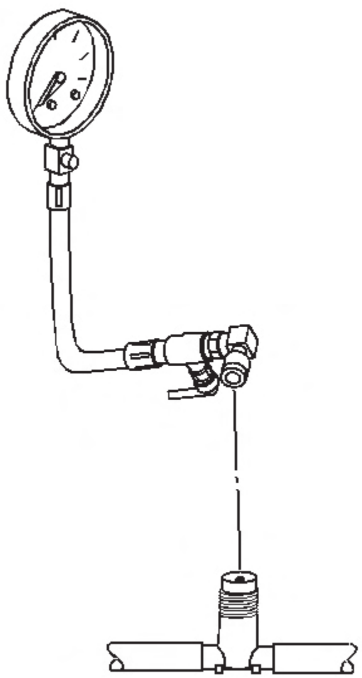
Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

CAUTION:

Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gage. Place the towel in an approved container when the connection of the fuel pressure gage is complete.

1. Remove the engine sight shield.
2. Remove the fuel rail pressure fitting cap.
3. Connect the J 34730-1A or the J-34730-FF to the fuel pressure valve. Wrap a shop towel around the fitting while connecting the gage in order to avoid spillage.
4. Install the bleed hose on the J 34730-1A or the J-34730-FF into an approved container.

Removal Procedure

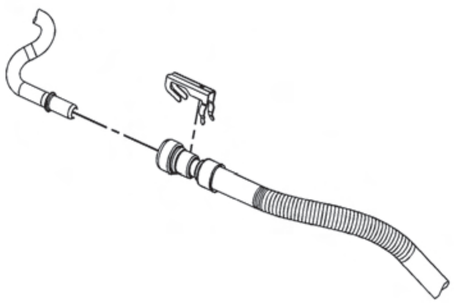


1. Remove the bleed hose on the J 34730-1A or the J-34730-FF from the approved container.
2. Remove the shop towel from around the fitting and discard into an approved container.
3. Disconnect the J 34730-1A or the J-34730-FF from the fuel pressure valve.
4. Install the fuel rail pressure fitting cap.
5. Install the engine sight shield.

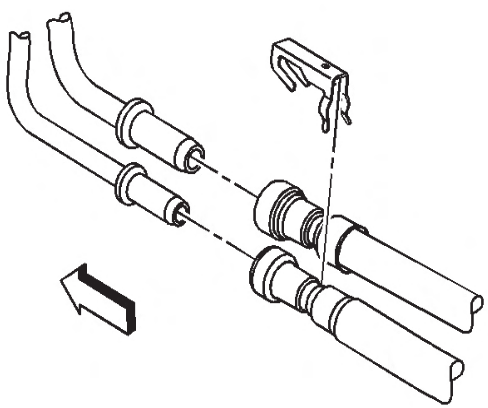
Metal Collar Quick Connect Fitting Service

Tools Required
- J 41769 Fuel Line Quick Disconnect Tool
- J 43178 Fuel Line Disconnect Tool

Removal Procedure



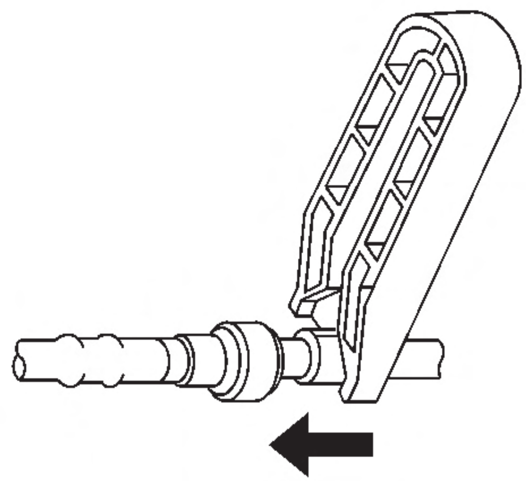
1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.
2. Remove the retainer from the fuel feed line to engine quick-connect fitting.



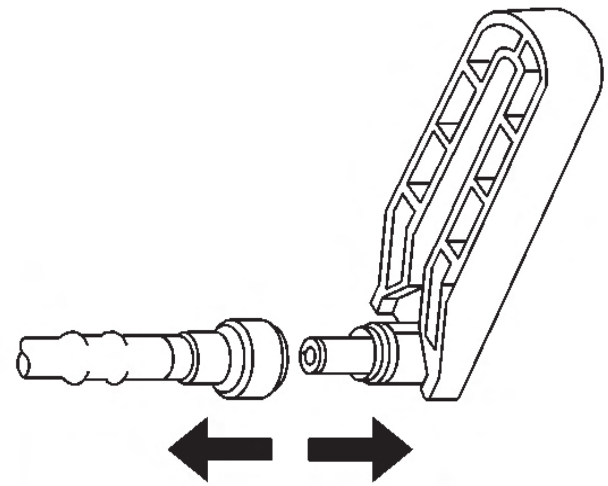
CAUTION:

Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Using compressed air, blow any dirt or debris from around the fitting.



4. Using the correct tool from J 41769 , insert the tool into the female connector, then push inward in order to release the quick connect locking tabs.
5. If the vehicle is a cab/chassis, it may be necessary to use J 43178 in order to release the quick connect locking tabs.



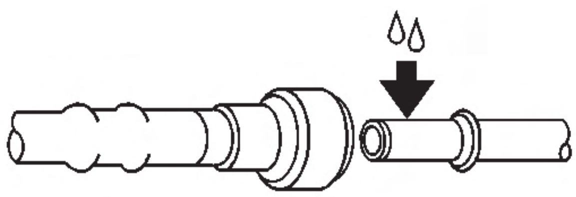
6. Pull the fuel line connection apart.

NOTICE:

If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

7. Use a clean shop towel in order to wipe off the male connection end.
8. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.

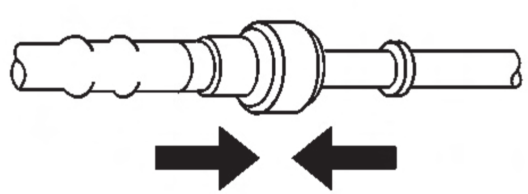
Installation Procedure



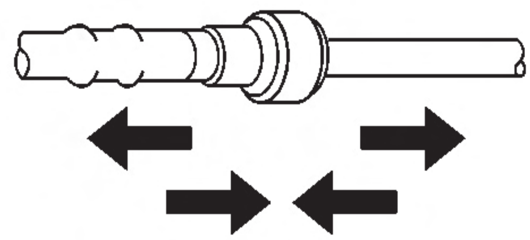
CAUTION:

In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.This will ensure proper reconnection and prevent a possible fuel leak.During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

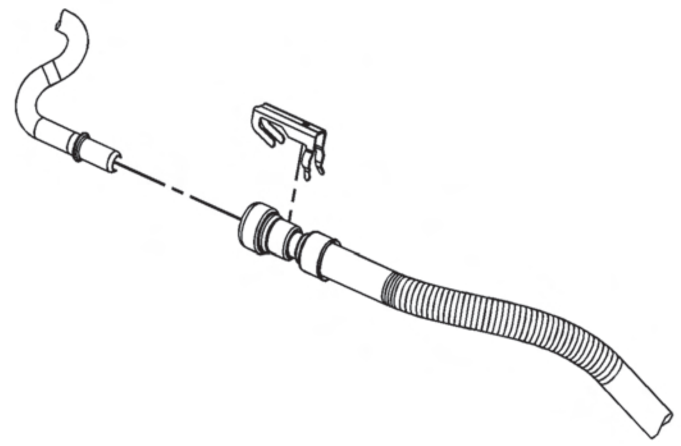
1. Apply a few drops of clean engine oil to the male connection end.



2. Push both sides of the fittings together in order to snap the retaining tabs into place.



3. Once installed, pull on both sides of the connection in order to make sure the connection is secure.

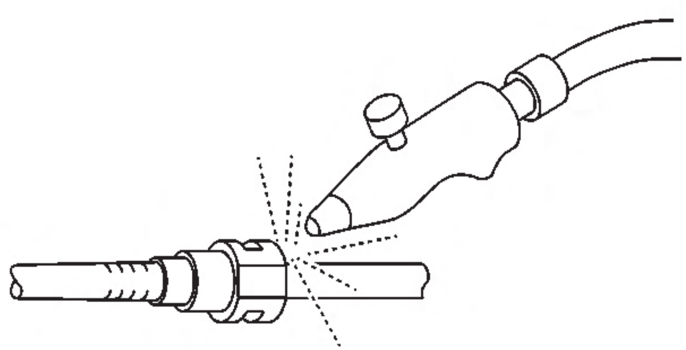


4. Install the retainer to the fuel feed line quick-connect fitting.
5. Install the fuel fill cap.
6. Connect the negative battery cable.

Plastic Collar Quick Connect Fitting Service

Removal Procedure

IMPORTANT:
There are several types of plastic fuel and evaporative emission (EVAP) quick connect fittings used on this vehicle. The following instructions apply to all types of plastic quick connect fittings except where indicated.

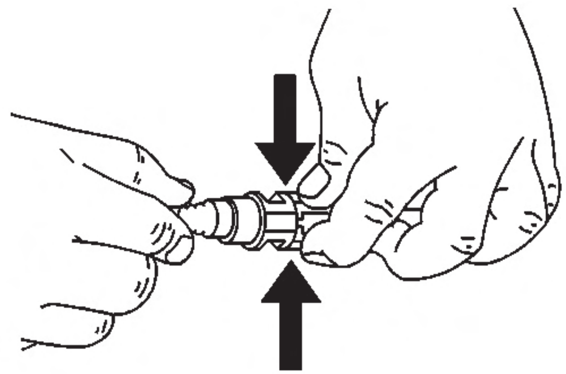


1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.

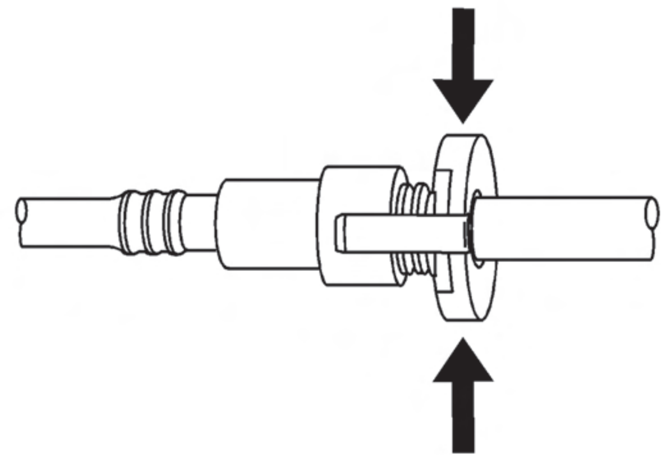
CAUTION:

Wear safety glasses when using compressed air in order to prevent eye injury.

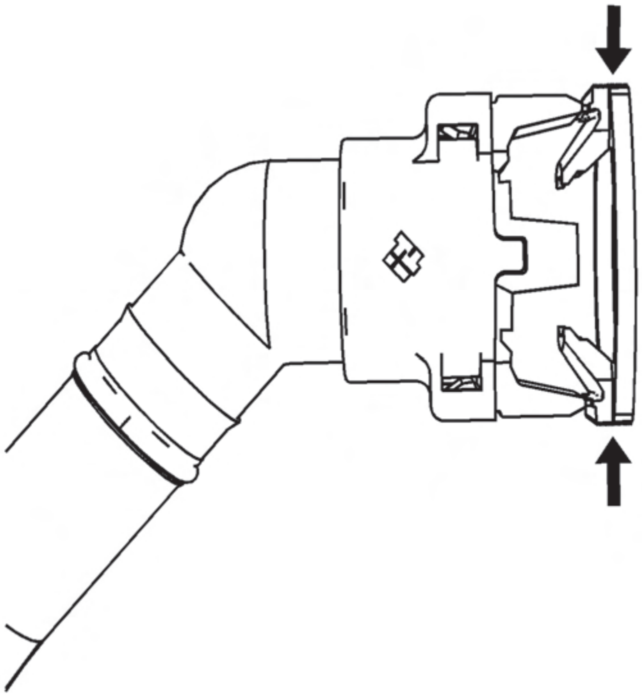
2. Using compressed air, blow any dirt or debris from around the quick connect fitting.



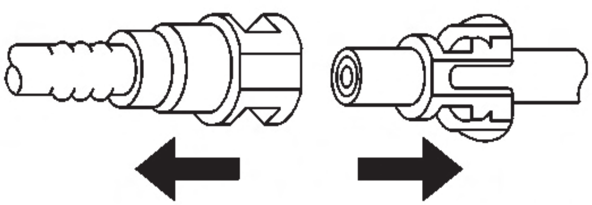
3. Squeeze the plastic quick connect fitting release tabs together to disengage the quick connect fitting. (This step applies to Bartholomew style fittings ONLY)



4. Squeeze where indicated by the arrows on both sides of the plastic ring to disengage the quick connect fitting.

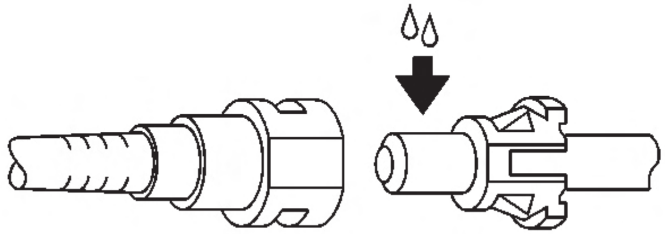


5. Squeeze where indicated by the arrows on both sides of the plastic ring to disengage the quick connect fitting.



6. Pull the quick connect fitting connection apart.

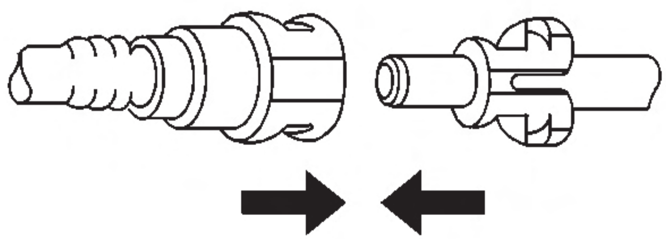
Installation Procedure



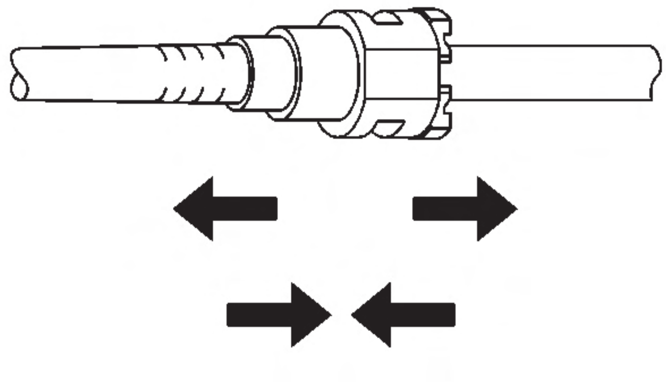
CAUTION:

In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.This will ensure proper reconnection and prevent a possible fuel leak.During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male connection end.



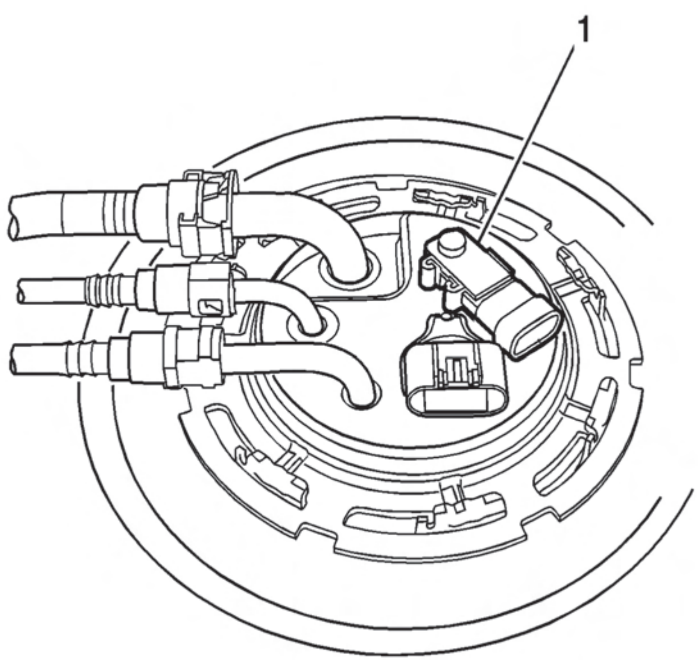
2. Push both sides of the quick-connect fitting together in order to cause the retaining tabs to snap into place.



3. Once installed, pull on both sides of the quick-connect fittings in order to make sure the connection is secure.

Fuel Tank Pressure Sensor Replacement

Removal Procedure



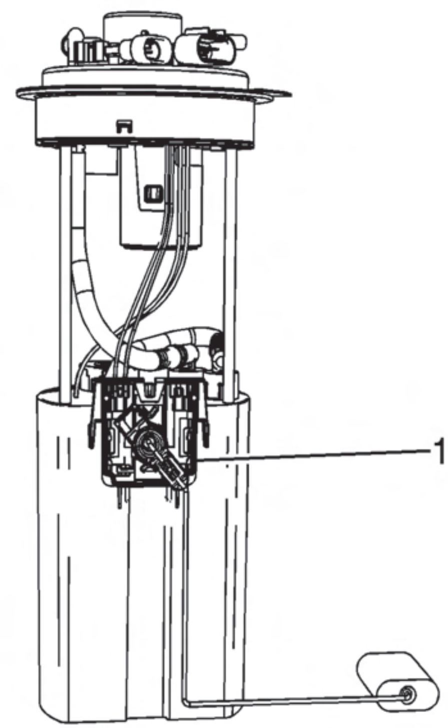
1. Remove the fuel tank.
2. Using a slight rocking motion, while pulling straight up, remove the fuel tank pressure sensor (1).

Installation Procedure

1. Install the fuel tank pressure sensor (1).
2. Install the fuel tank.

Fuel Level Sensor Replacement (4.8L and 6.0L Engines)

Removal Procedure



1. Remove the sending unit. Refer to Fuel Sender Assembly Replacement.
2. Disconnect the fuel pump electrical connector.

3. Remove the fuel lever sensor electrical connector retaining clip.
4. Disconnect the fuel level sensor electrical connector.
5. Remove the fuel level sensor retaining clip.
6. Remove the fuel level sensor (1).

Installation Procedure

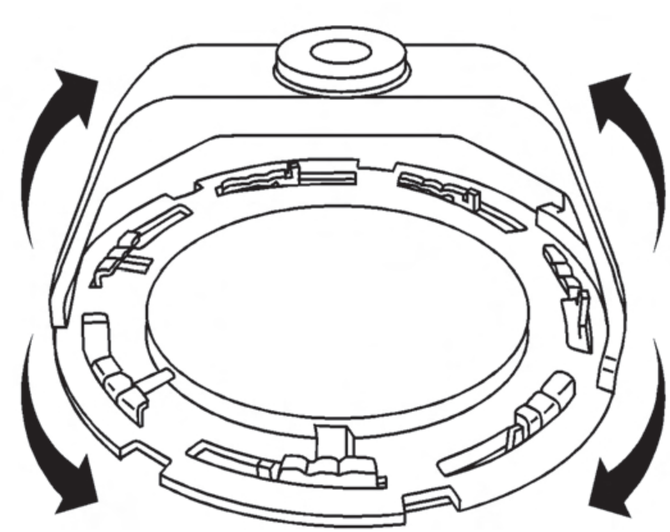
1. Install the fuel level sensor (1).
2. Install the fuel level sensor retaining clip.
3. Connect the fuel level sensor electrical connector.
4. Install the fuel lever sensor electrical connector retaining clip.
5. Connect the fuel pump electrical connector.
6. Install the sending unit. Refer to Fuel Sender Assembly Replacement.

Fuel Sender Assembly Replacement (4.8L and 6.0L Engines)

Tools Required

- J 45722 Fuel Sender Lock Ring Wrench

Removal Procedure



1. Remove the fuel tank.
2. Disconnect the fuel line from the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar).
3. Disconnect the evaporative emission (EVAP) line from the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar).

CAUTION:

Drain the fuel from the fuel sender assembly into an approved container in order to reduce the risk of fire and personal injury. Never store the fuel in an open container.

NOTICE:

Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

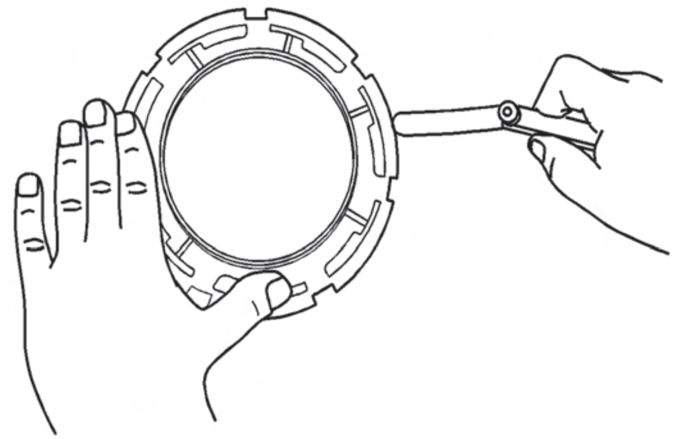
NOTICE:

Do Not handle the fuel sender assembly by the fuel pipes. The amount of leverage generated by handling the fuel pipes could damage the joints.

IMPORTANT:

Do NOT use impact tools. Significant force will be required to release the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

4. Use the J 45722 and a long breaker-bar in order to unlock the fuel sender lock ring.
5. Remove the sending unit and seal. Discard the seal.
6. Clean the sending unit sealing surfaces. Turn the fuel sender lock ring in a counterclockwise direction.



IMPORTANT:

Some lock rings were manufactured with “DO NOT REUSE” stamped into them. These lock rings may be reused if they are not damaged or warped.

IMPORTANT:

Inspect the lock ring for damage due to improper removal or installation procedures. If damage is found, install a NEW lock ring.

IMPORTANT:

Check the lock ring for flatness.

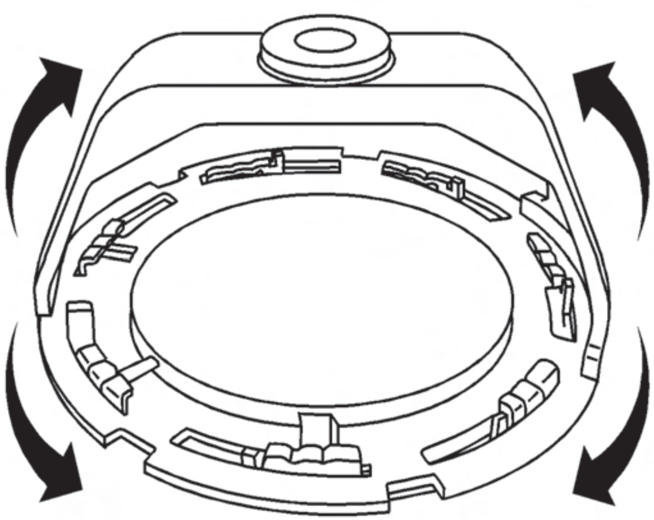
7. Place the lock ring on a flat surface. Measure the clearance between the lock ring and the flat surface using a feeler gage at 7 points.
8. If warpage is less than 0.41 mm (0.016 in), the lock ring does not require replacement.
9. If warpage is greater than 0.41 mm (0.016 in), the lock ring must be replaced.

Installation Procedure

CAUTION:

In order to reduce the risk of fire and personal injury that may result from a fuel leak, always replace the fuel sender gasket when reinstalling the fuel sender assembly.

IMPORTANT:
The fuel strainer must be in a horizontal position when installing the sending unit is installed in the tank. When installing the sending unit, assure that the fuel strainer does not block full travel of the float arm.



1. Install the sending unit.

IMPORTANT:
Always replace the fuel sender seal when installing the fuel sender assembly. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

IMPORTANT:
Ensure the lock ring is installed with the correct side facing upward. A correctly installed lock ring will only turn in a clockwise direction.

2. Use the J 45722 in order to install the fuel sender lock ring. Turn the fuel sender lock ring in a clockwise direction.
3. Connect the EVAP line to the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar).
4. Connect the fuel line to the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar).
5. Install the fuel tank.

Fuel System Cleaning

Fuel Tank Cleaning

IMPORTANT:
- *Only use oil free compressed air to blow out the fuel pipes.*
- *Inspect the fuel tank internally and clean the fuel tank if you find a plugged fuel filter.*

1. Disconnect the negative battery cable.
2. Remove the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
3. Inspect the fuel pump strainer. Replace a contaminated strainer and inspect the fuel pump.
4. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet.

IMPORTANT:
When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water mixture in accordance with all applicable local, state, and federal laws and regulations.

5. Flush the fuel tank with hot water.
6. Pour the water out of the fuel sender assembly opening. Rock the tank to be sure that removal of the water from the tank is complete.
7. Remove the fuel rail assembly. Refer to Fuel Rail Assembly Replacement.
8. Drain the fuel from the fuel rail. It will be necessary to remove the fuel injectors from the fuel rail to properly clear all debris from the fuel rail and fuel injectors. Use light shop air to remove any debris from the fuel rail and injectors.
9. Replace the fuel injector O-rings.
10. Use light shop air in the opposite direction of the fuel flow in order to remove any debris from the fuel lines. Catch any fuel from the fuel lines with an approved gasoline container.
11. Install the injectors to the fuel rail.
12. Install the fuel rail assembly onto the engine. Refer to Fuel Rail Assembly Replacement.
13. If equipped with a serviceable fuel filter, replace the fuel filter.
14. Install the fuel sender assembly. Refer to Fuel Sender Assembly Replacement.
15. Connect the negative battery cable.

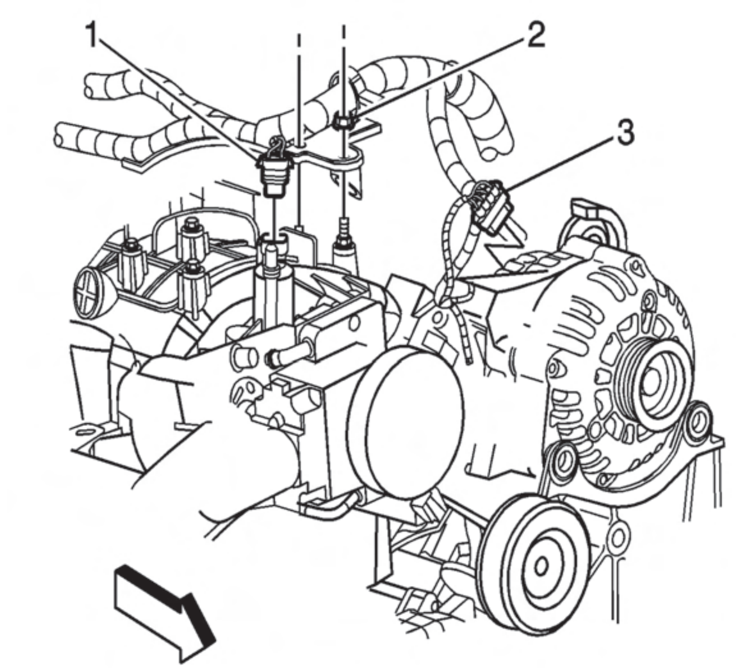
IMPORTANT:
If the fuel pump or sender assembly was not replaced, purge the fuel sender assembly.

16. Purge the fuel sender assembly.
    16.1. Disconnect the fuel feed line from the fuel filter, if equipped. Otherwise, disconnect the fuel feed line at the fuel tank.
    16.2. Connect a length of hose to the fuel feed pipe.
    16.3. Insert the other end of the hose into an empty 3.8 liter (1 gallon) approved gasoline container.
    16.4. Add 23 liters (6 gallons) of clean fuel into the fuel tank.
    16.5. Turn on the fuel pump using the scan tool until 2 liters (1/2 gallon) of fuel flows into the fuel container.
17. Inspect for leaks.
    17.1. Turn the ignition switch ON for 2 seconds.
    17.2. Turn the ignition switch OFF for 10 seconds.
    17.3. Turn the ignition switch ON.
    17.4. Inspect for fuel leaks.

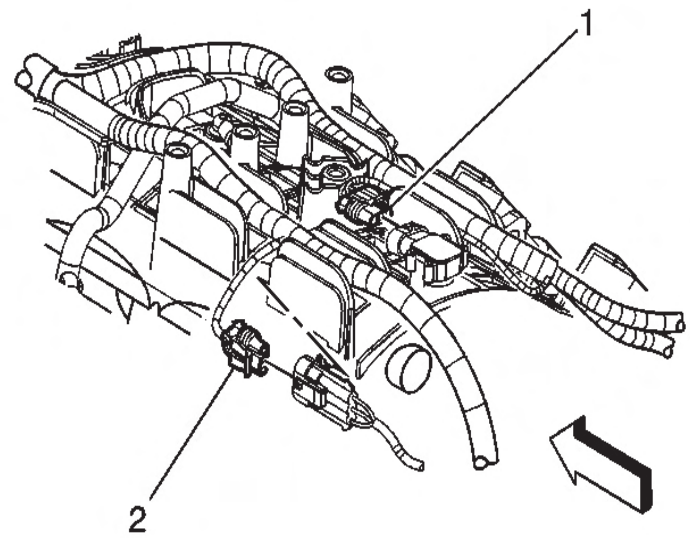
Fuel Injection Fuel Rail Assembly Replacement (4.8L and 6.0L Engines)

Removal Procedure

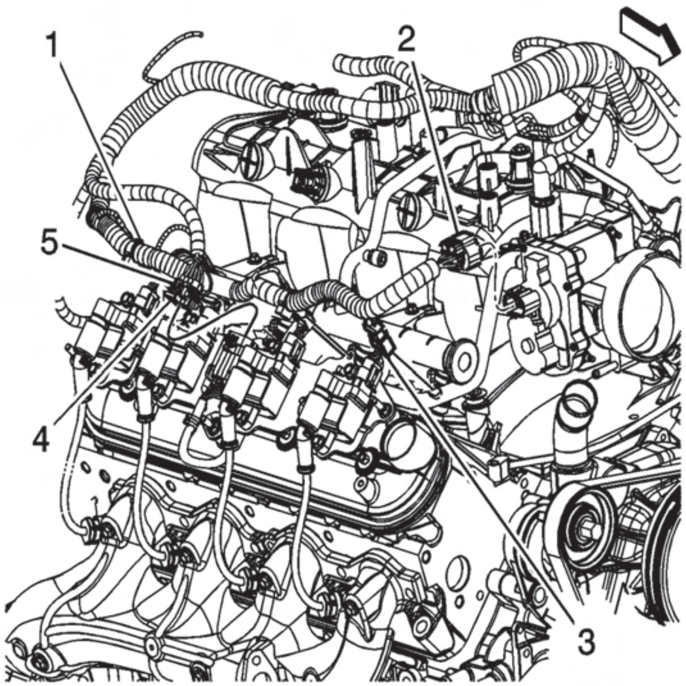
IMPORTANT:
An 8-digit identification number (1) is located on the fuel rail. Refer to this identification number when servicing or when part replacement is required.

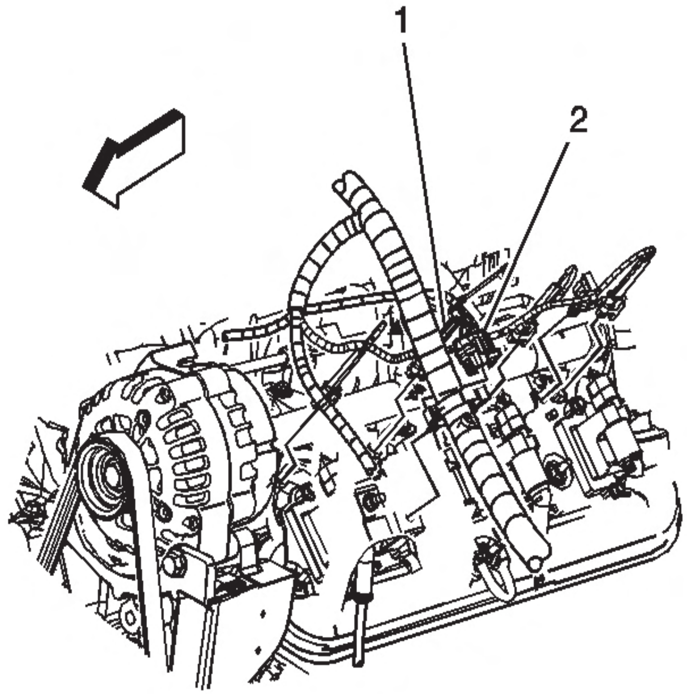


1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.
2. Remove the wire harness bracket nut (2).
3. Disconnect the evaporative emission (EVAP) purge solenoid electrical connector (1).
4. Disconnect the generator electrical connector (3).

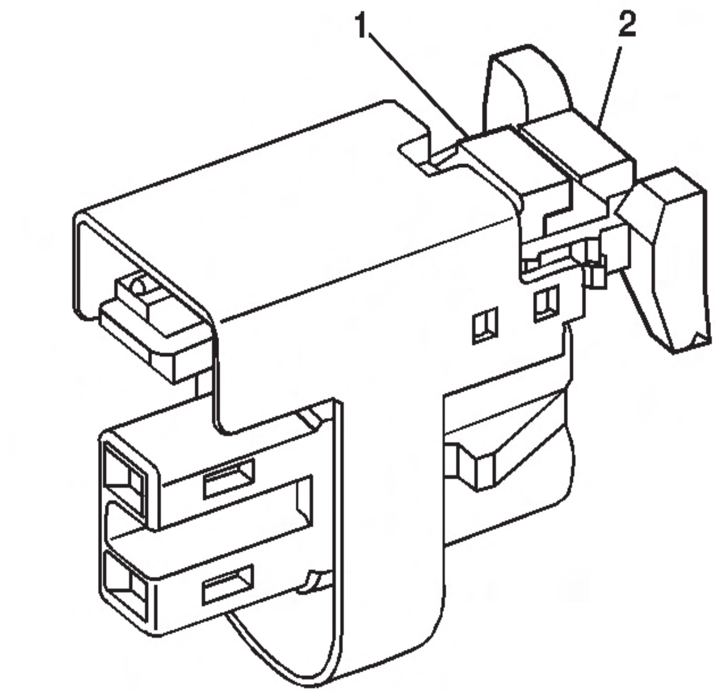


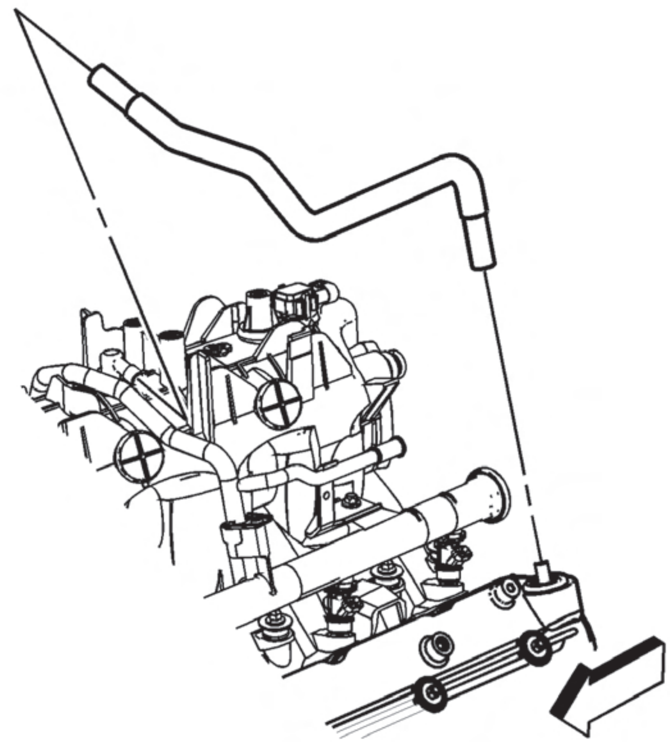
5. Disconnect the following electrical connectors:
   - Manifold absolute pressure (MAP) sensor (1)
   - Knock sensor (2)
6. Remove the knock sensor harness connector from the intake manifold.





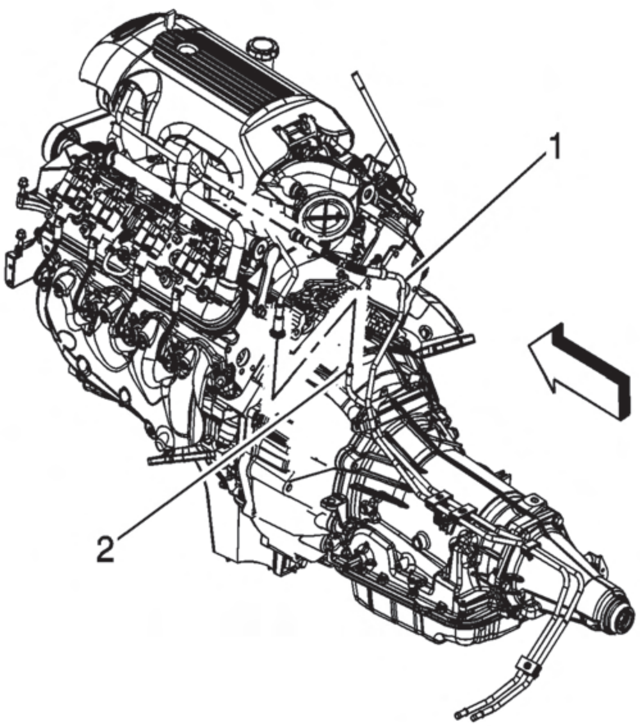
7. Disconnect the electronic throttle control (ETC) electrical connector (2), preform the following:
7.1. Disengage the gray retainer.
7.2. Push down the black clip.
7.3. Disconnect the connector.
8. Remove the connector position assurance (CPA) retainer (5).
9. Disconnect the following electrical connectors from the right side of the engine:
   - Main coil (4)
   - Fuel injectors (3)
10. Remove the harness clips from the fuel rail (1).
11. Remove the CPA retainer from the left side of the engine.
12. Disconnect the following electrical connectors from the left side of the engine:
   - Main coil (2)
   - Fuel injectors
13. Remove the harness clips from the fuel rail (1).
14. Reposition the engine wire harness aside.

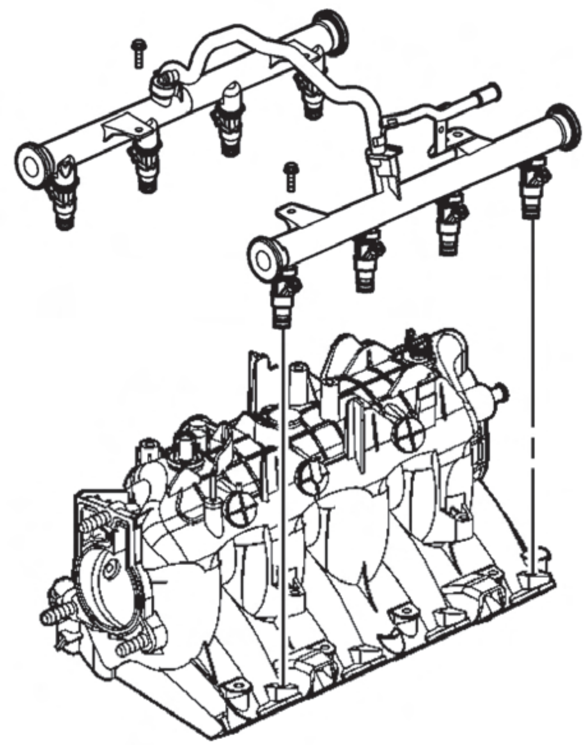




15. Perform the following steps in order to disconnect the fuel injector electrical connectors.
    15.1. Mark the connectors to their corresponding injectors to ensure correct reassembly.
    15.2. Pull the connector position assurance (CPA) retainer (2) on the connector up 1 click.
    15.3. Push the tab (1) on the connector in.
    15.4. Disconnect the fuel injector electrical connector.
    15.5. Repeat the steps for each injector electrical connector.

16. Remove the positive crankcase ventilation (PCV) hose.





17. Disconnect the fuel feed pipe (1) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.

18. Remove the fuel rail bolts.

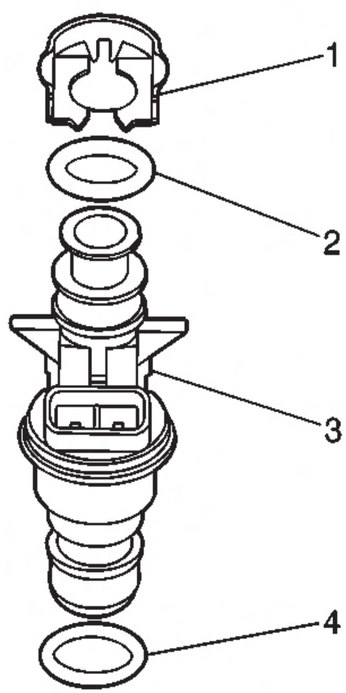
NOTICE:

- *Remove the fuel rail assembly carefully in order to prevent damage to the injector electrical connector terminals and the injector spray tips. Support the fuel rail after the fuel rail is removed in order to avoid damaging the fuel rail components.*
- *Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering open pipes and passages.*

IMPORTANT:

Before removal, clean the fuel rail with a spray type engine cleaner, such as GM X-30A or equivalent, if necessary. Follow the package instructions. Do not soak the fuel rail in liquid cleaning solvent.

19. Remove the fuel rail.



20. Remove the fuel injector lower O-ring seal (4) from each injector, if necessary.
21. Discard the O-ring seal.

Installation Procedure

1. Lubricate NEW fuel injector lower O-ring seals (4) with clean engine oil.
2. Install the NEW O-ring seals (4) onto each injector, if necessary.
3. Install the fuel rail.
4. Apply a 5 mm (0.2 in) band of threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent to the threads of the fuel rail bolts.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

5. Install the fuel rail bolts and tighten the bolts to 10 N·m (89 lb in).
6. Connect the fuel feed pipe (1) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
7. Install the PCV hose.
8. Perform the following steps in order to connect the fuel injector electrical connectors.
   8.1. Install the connectors to their corresponding injectors to ensure correct reassembly.
   8.2. Connect the fuel injector electrical connector.
   8.3. Push the CPA retainer (2) on the connector in 1 click.
   8.4. Repeat the steps for each injector electrical connector.
9. Position the engine wire harness.
10. Connect the following electrical connectors to the left side of the engine:
    - Main coil (2)
    - Fuel injectors

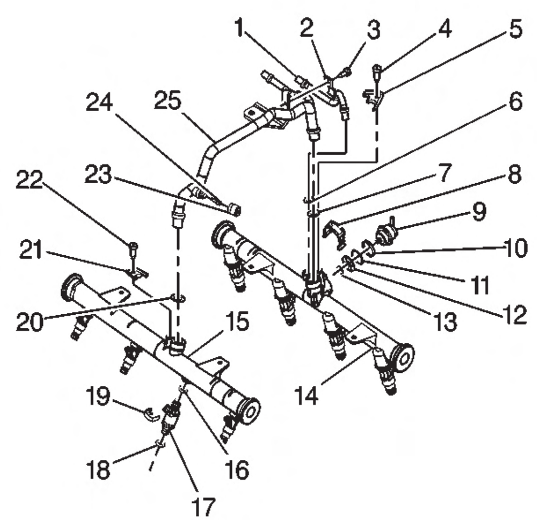
11. Install the harness clips to the fuel rail (1).
12. Install the CPA retainer.
13. Connect the following electrical connectors to the right side of the engine:
    - Main coil (4)
    - Fuel injectors (3)
14. Install the CPA retainer (5).
15. Install the harness clips to the fuel rail (1).
16. Connect the ETC electrical connector (2), preform the following:
    16.1. Connect the connector.
    16.2. Engage the gray retainer.
17. Connect the following electrical connectors:
    - MAP sensor (1)
    - Knock sensor (2)
18. Install the knock sensor harness connector to the intake manifold.
19. Connect the EVAP purge solenoid electrical connector (1).
20. Connect the generator electrical connector (3).
21. Install the wire harness bracket nut (2) and tighten the nut to 5 N·m (44 lb in).
22. Tighten the fuel fill cap.
23. Connect the negative battery cable.
24. Use the following procedure in order to inspect for leaks:
    24.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    24.2. Turn the ignition OFF for 10 seconds.
    24.3. Turn the ignition ON, with the engine OFF.
    24.4. Inspect for fuel leaks.

Fuel Injector Replacement

Removal Procedure

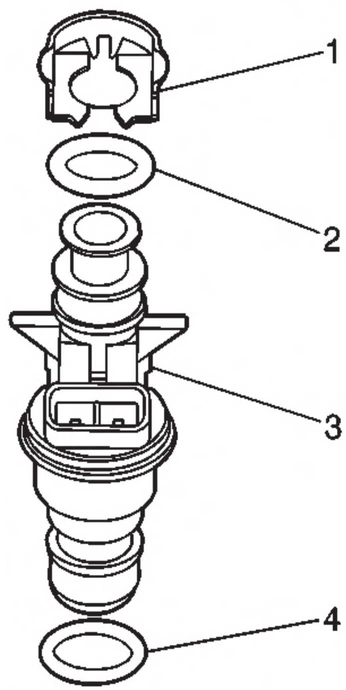
NOTICE:
Use care in removing the fuel injectors in order to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. Do not immerse the fuel injector in any type of cleaner. The fuel injector is an electrical component and may be damaged by this cleaning method.

IMPORTANT:
The engine oil may be contaminated with fuel if the fuel injectors are leaking.



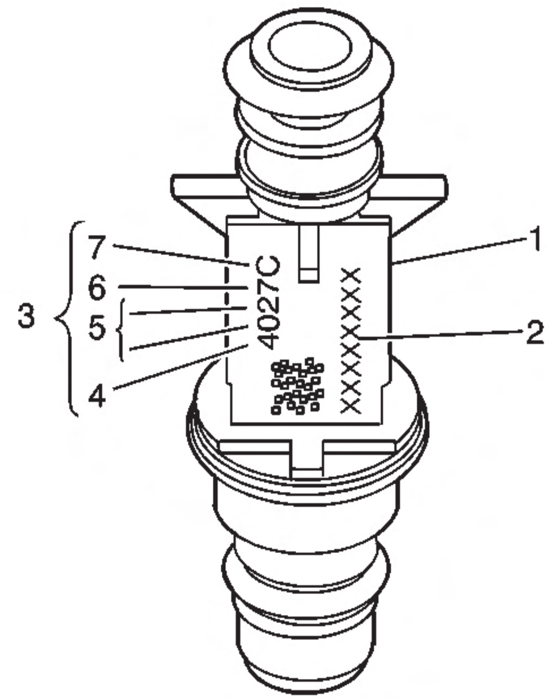
1. Remove the fuel rail. Refer to Fuel Rail Assembly Replacement.

2. Remove and discard the fuel injector retainer clip (19).
3. Remove the fuel injector (17).

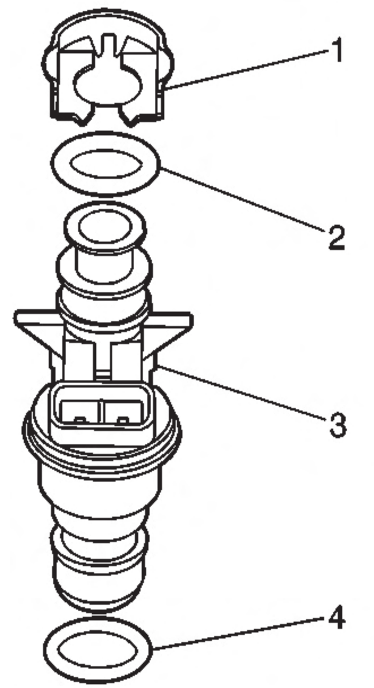


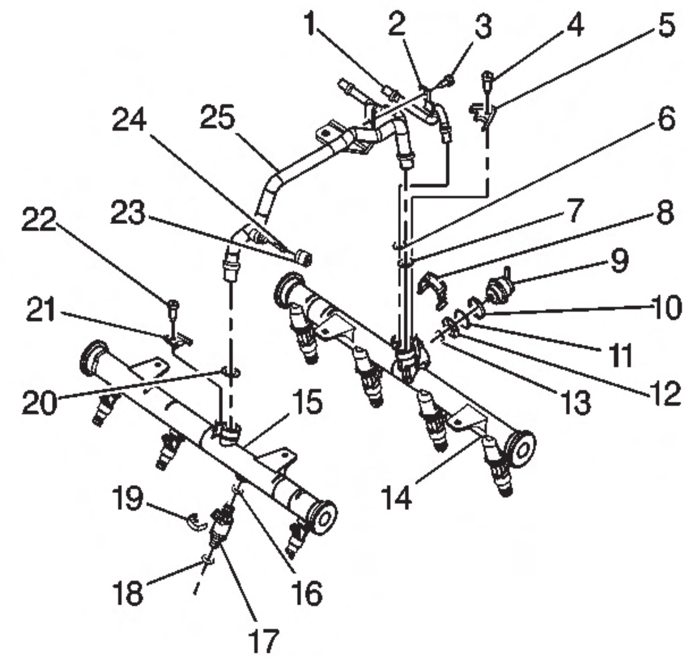
4. Remove and discard the fuel injector retainer clip (1).
5. Remove and discard the fuel injector O-ring seals (2, 4).

Installation Procedure



IMPORTANT:
When ordering new fuel injectors, you must order the correct injector for the application being serviced. The fuel injector (1) is stamped with a identification part number (2). A four-digit build date code (3) indicates the month (4), day (5), year (6), and shift (7) that built the injector.





1. Lubricate the NEW injector O-ring seals (2, 4) with clean engine oil.
2. Install the NEW injector O-ring seals onto the fuel injector.
3. Install a NEW retainer clip (1) onto the fuel injector.
4. Push the fuel injector (17) into the fuel rail injector socket with the electrical connector facing outward. The retainer clip (19) locks on to a flange on the fuel rail injector socket.
5. Install the fuel rail. Refer to Fuel Rail Assembly Replacement.

Fuel Injector Cleaning

Tools Required

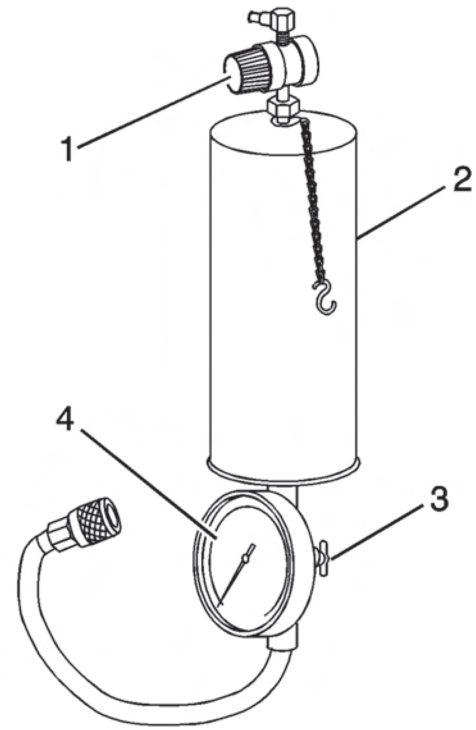
- J 37287 Fuel Line Shut-Off Adapters
- J 35800-A Fuel Injector Cleaner
- J 42873-1 3/8 Fuel Line Shut-Off Valve
- J 42873-2 5/16 Return Pipe Shut-Off Valve
- J 42964-1 3/8 Fuel Pipe Shut-Off Valve
- J 42964-2 5/16 Fuel Pipe Shut-Off Valve

NOTICE:

- *GM Top-Engine Cleaner is the only injector cleaning agent recommended. Do not use other cleaning agents, as they may contain methanol which can damage fuel system components.*
- *Under NO circumstances should the top engine cleaner be added to the vehicles fuel tank, as it may damage the fuel pump and other system components.*
- *Do not exceed a 10 percent cleaning solution concentration. Higher concentrations may damage fuel system components. Testing has demonstrated that exceeding the 10 percent cleaning solution concentration does not improve the effectiveness of this procedure.*

IMPORTANT:
Vehicles with less than 160 km (100 mi) on the odometer should not have the injectors cleaned. These vehicles should have the injectors replaced.

IMPORTANT:
During this procedure you will need a total of 960 ml (32.4 oz) of cleaning solution. That is 2 tanks of solution for the J 35800-A. Other brands of tools may have a different capacity and would therefore require more or less tanks to complete the procedure. You must use all 960 ml (32.4 oz) of solution to ensure complete injector cleaning.



1. Obtain J 35800-A (2).

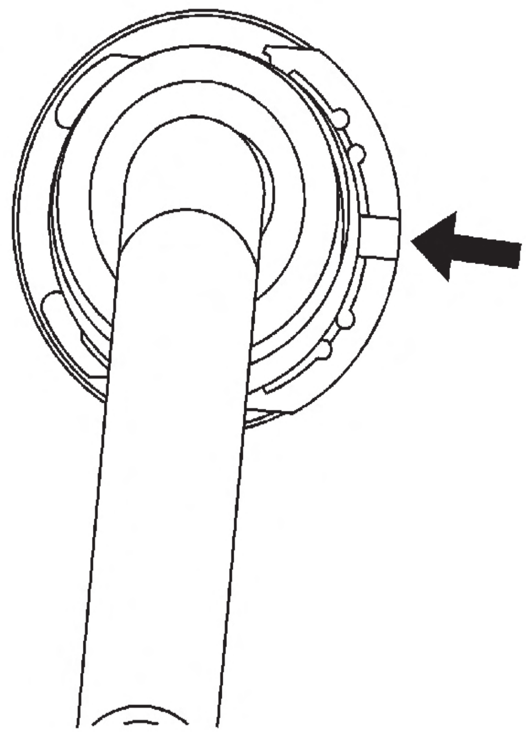
IMPORTANT:
Make sure the valve at the bottom of the canister (3) is closed.

2. For US dealers, empty 2 pre-measured GM Top-Engine Cleaner containers, 24 ml (0.812 oz) each, GM P/N 12346535, into the J 35800-A.

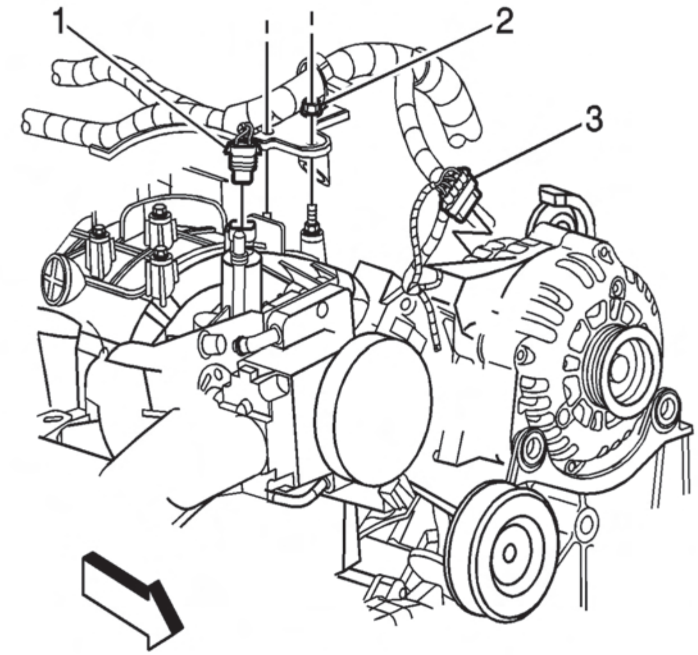
3. For Canadian dealers, measure and dispense 48 ml (1.62 oz) of Top-Engine Cleaner, Canadian P/N 992872, into the J 35800-A.
4. If you are using any other brand of tank you will need a total of 96 ml (3.24 oz) of Top-Engine Cleaner mixed with 864 ml (29.16 oz) of regular unleaded gasoline.
5. Fill the injector cleaning tank with regular unleaded gasoline. Be sure to follow all additional instructions provided with the tool.
6. Electrically disable the vehicle fuel pump by removing the fuel pump relay and disconnecting the oil pressure switch connector, if equipped.
7. Disconnect the fuel feed and return line, if equipped, at the fuel rail. Plug the fuel feed and return line, if equipped, coming off the fuel rail with J 37287 , or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 as appropriate for the fuel system.
8. Connect the J 35800-A to the vehicle fuel rail.
9. Pressurize the J 35800-A to 510 kPa (75 psi).
10. Start and idle the engine until it stalls due to lack of fuel. This should take approximately 15-20 minutes.
11. Disconnect J 35800-A from the fuel rail.
12. Reconnect the vehicle fuel pump relay and oil pressure switch connector, if equipped.
13. Remove J 37287 or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 and reconnect the vehicle fuel feed and return lines.
14. Start and idle the vehicle for an additional 2 minutes to ensure residual injector cleaner is flushed from the fuel rail and fuel lines.
15. Repeat steps 1-5 of the Injector Balance Test, and record the fuel pressure drop from each injector.
16. Subtract the lowest fuel pressure drop from the highest fuel pressure drop. If the value is 15 kPa (2 psi) or less, no additional action is required. If the value is greater than 15 kPa (2 psi), replace the injector with the lowest fuel pressure drop.
17. Add one ounce of Port Fuel Injector Cleaner, GM P/N 12345104 (Canadian P/N 10953467), to the vehicle fuel tank for each gallon of gasoline estimated to be in the fuel tank. Instruct the customer to add the reminder of the bottle of Port Fuel Injector Cleaner to the vehicle fuel tank at the next fill-up.
18. Advise the customer to change brands of fuel and to add GM Port Fuel Injector Cleaner every 5 000 km (3,000 mi). GM Port Fuel Injector Cleaner contains the same additives that the fuel companies are removing from the fuel to reduce costs. Regular use of GM Port Fuel Injector Cleaner should keep the customer from having to repeat the injector cleaning procedure.
19. Road test the vehicle to verify that the customer concern has been corrected.

Evaporative Emission Canister Purge Solenoid Valve Replacement

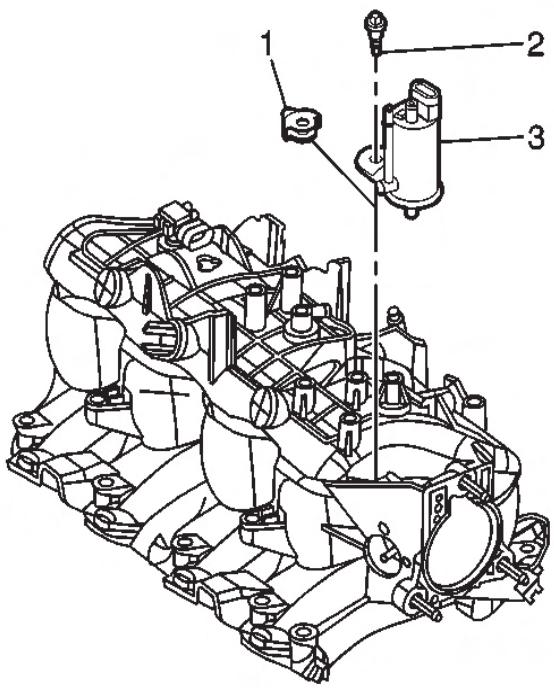
Removal Procedure



1. Remove the engine sight shield.
2. Remove the evaporative emission (EVAP) line from the canister purge solenoid, perform the following:
   2.1. Push the large size white retainer portion in.
   2.2. Push down, while pulling up slightly in order the disengage the tube.



3. Disconnect the EVAP canister purge solenoid electrical connector (1).



4. Remove the EVAP canister purge solenoid bolt (2).
5. Remove the EVAP canister purge solenoid (3) and insulator (1).

Installation Procedure

1. Install the insulator (1) onto the EVAP canister purge solenoid (3).
2. Install the EVAP canister purge solenoid (3).

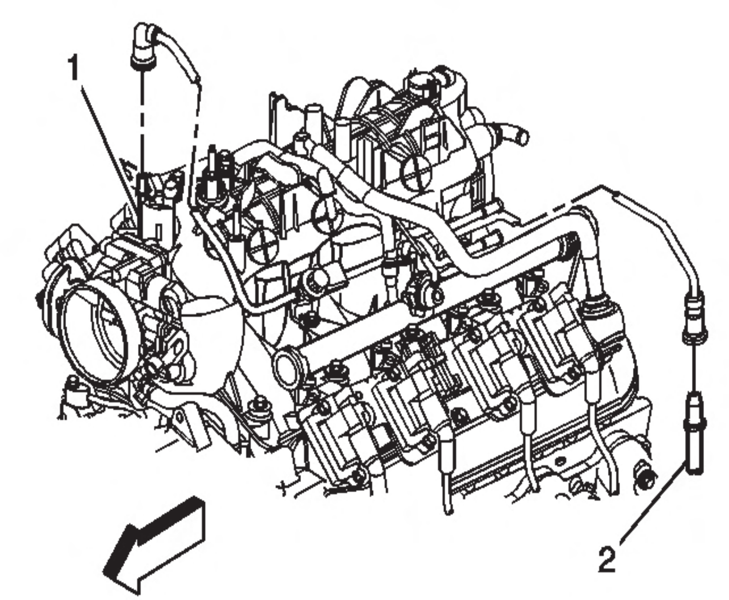
NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

3. Install the EVAP canister purge solenoid bolt (2) and tighten the bolt to 10.5 N·m (93 lb in).
4. Connect the EVAP canister purge solenoid electrical connector (1).
5. Install the EVAP line to the canister purge solenoid (1).
6. Install the engine sight shield.

Evaporative Emission Hoses/Pipes Replacement - Engine

Removal Procedure

IMPORTANT:
Clean the evaporative emission (EVAP) line connections and surrounding areas prior to disconnecting the fittings in order to avoid possible system contamination.



1. Remove the engine sight shield.
2. Disconnect the EVAP tube from the EVAP canister purge solenoid (1).
   2.1. Push the large side white retainer portion in.
   2.2. Push down, while pulling up slightly in order to disengage the tube.
3. Disconnect the EVAP tube from the chassis EVAP pipe (2).
   3.1. Push the large side white retainer portion in.
   3.2. Push down, while pulling up slightly in order to disengage the tube.
4. Remove the EVAP tube.
5. Cap the EVAP canister purge solenoid and EVAP chassis pipe in order to prevent possible EVAP system contamination.

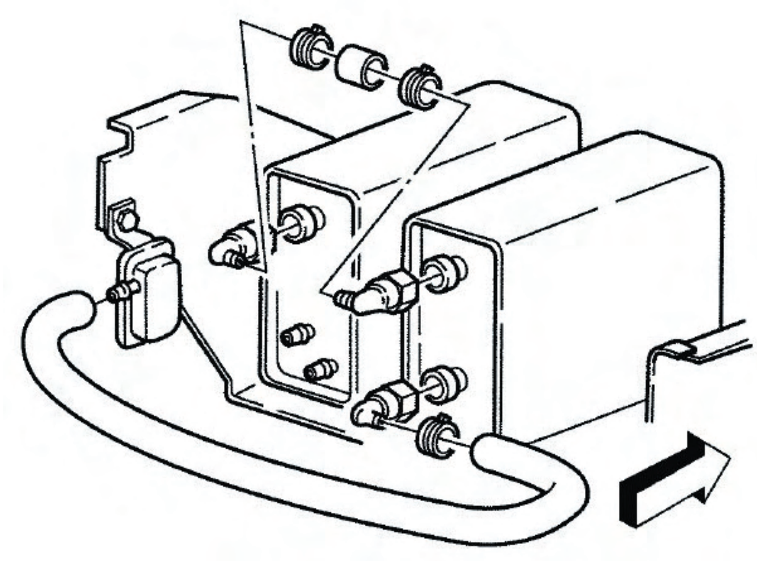
Installation Procedure

1. Remove the caps from the EVAP canister purge solenoid and EVAP chassis pipe.
2. Install the EVAP tube.
3. Connect the EVAP tube to the EVAP chassis pipe (2).
4. Connect the EVAP tube to the EVAP purge solenoid (1).
5. Install the engine sight shield.

Evaporative Emission (EVAP) Canister Replacement

Removal Procedure

1. Disconnect the evaporative emission (EVAP) vent hose from the EVAP canister.
2. Disconnect the EVAP purge pipe and the pipe to the fuel tank vapor pipe from the EVAP canister.
3. Remove the EVAP vent valve from the EVAP canister bracket.
4. Remove the EVAP canister bracket nut.
5. Remove the EVAP canister from the EVAP canister bracket.



Installation Procedure

1. Install the EVAP canister into the EVAP canister bracket.

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

2. Install the EVAP canister bracket nut and tighten the nut to 5 n m (44 lb in).
3. Install the EVAP vent valve to the canister bracket.
4. Connect the EVAP purge pipe and the fuel tank vapor pipe to the EVAP canister.
5. Connect the EVAP vent hose to the EVAP canister.

Evaporative Emission System Cleaning

Tools Required

- J 41413-200 EVAP Pressure/Purge Diagnostic Station

Inspection Procedure

IMPORTANT:
Do not perform this procedure unless instructed by an EVAP diagnostic.

1. Turn OFF the ignition.
2. Remove the EVAP canister purge valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
3. Lightly tap the EVAP canister purge valve on a clean hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
   - If no carbon particles are found reinstall the EVAP canister purge valve and continue with the EVAP cleaning procedure. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.

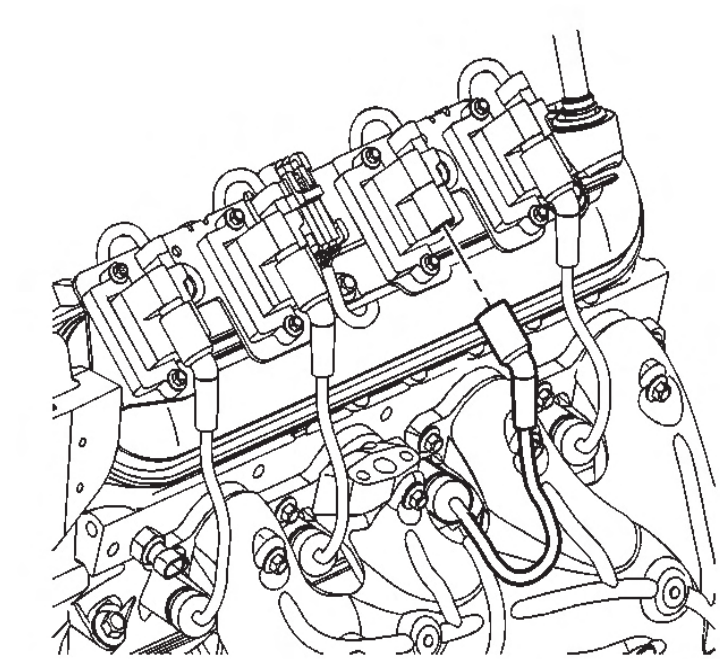
- If carbon particles are found during the inspection procedure, replace the EVAP canister purge valve and continue with the EVAP cleaning procedure. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
- If you were instructed to replace the EVAP canister purge valve, and no carbon particles are found, return to the EVAP diagnostic procedure. Do not perform the EVAP cleaning procedure.

EVAP Cleaning Procedure

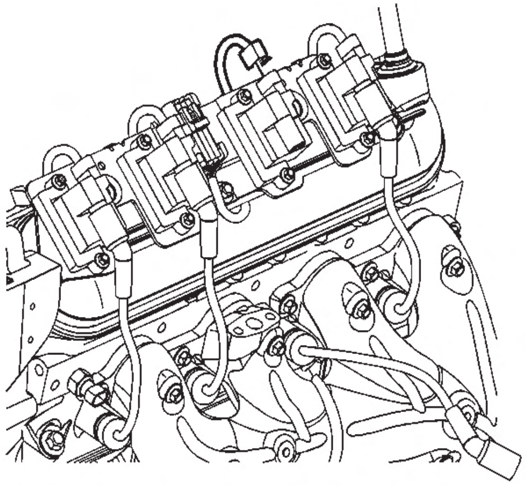
1. Remove the EVAP canister. Refer to Evaporative Emission Canister Replacement.
2. Turn OFF the main valve on J 41413-200.
3. Disconnect the hose from the diagnostic station pressure regulator.
4. Using a section of vacuum hose, connect one end to the diagnostic station pressure regulator.
5. Connect the other end of the vacuum hose to the canister side of the purge pipe.
6. Turn ON the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
7. If the nitrogen does not dislodge the carbon particles, replace the purge pipe.
8. Return the EVAP pressure/purge diagnostic station to the stations original condition.
9. Install a new EVAP canister. Refer to Evaporative Emission Canister Replacement.
10. Connect all previously disconnected EVAP pipe connectors.
11. Lower the vehicle.
12. Continue with the published service manual diagnostic DTC procedure.

Ignition Coil Replacement

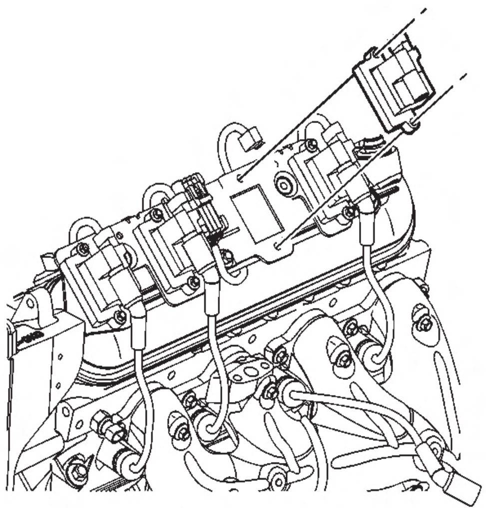
Removal Procedure



1. Remove the spark plug wire from the ignition coil.



2. Disconnect the ignition coil electrical connector.
3. Remove the ignition coil bolts.



4. Remove the ignition coil.

Installation Procedure

1. Install the ignition coil.

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

2. Install the ignition coil bolts and tighten the bolts to 8 N·m (71 lb in).
3. Connect the ignition coil electrical connector.
4. Install the spark plug wire to the ignition coil.

Spark Plug Wire Inspection

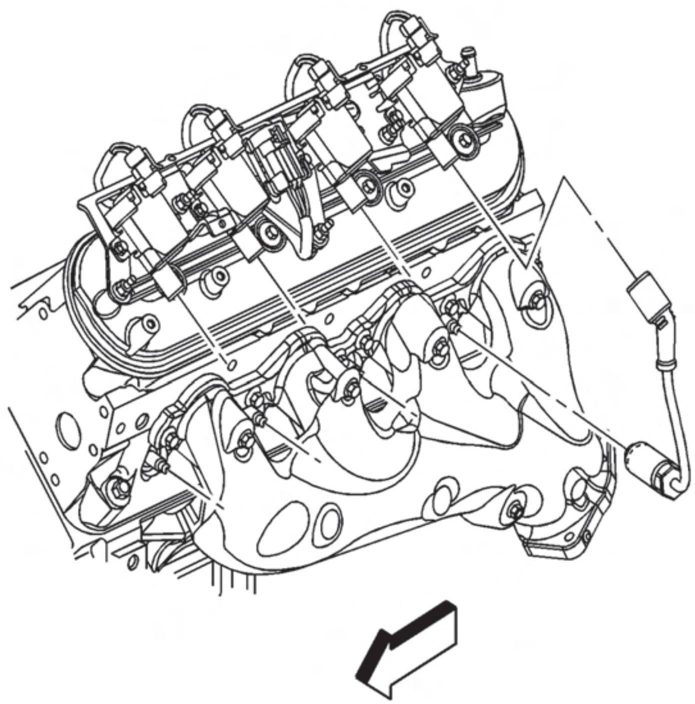
Spark plug wire integrity is vital for proper engine operation. A thorough inspection is necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Correct routing of the spark plug wires-Incorrect routing may cause cross-firing.
2. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
   - Tearing
   - Piercing
   - Arcing
   - Carbon tracking
   - Corroded terminal

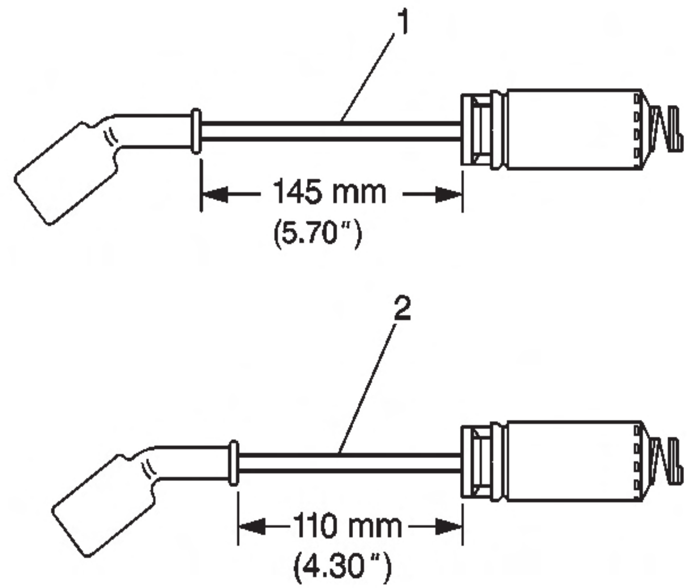
If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or terminal, replace the wire and the component connected to the wire.

Spark Plug Wire Replacement

Removal Procedure



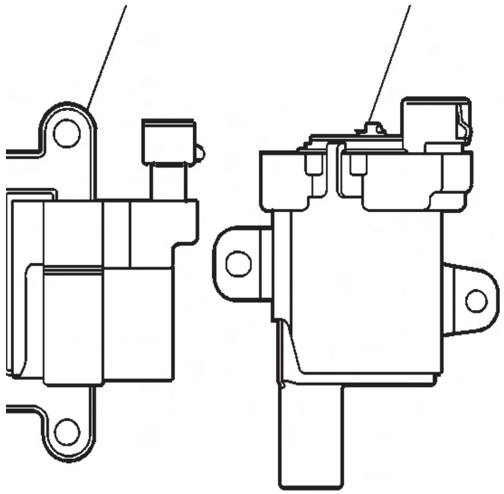
1. Remove the spark plug wire from the spark plug.
   A. Twist the spark plug wire boot a 1/2 turn.
   B. Pull only on the boot in order to remove the wire from the spark plug.
2. Remove the spark plug wire from the ignition coil.
   A. Twist the spark plug wire boot a 1/2 turn.
   B. Pull only on the boot in order to remove the wire from the ignition coil.



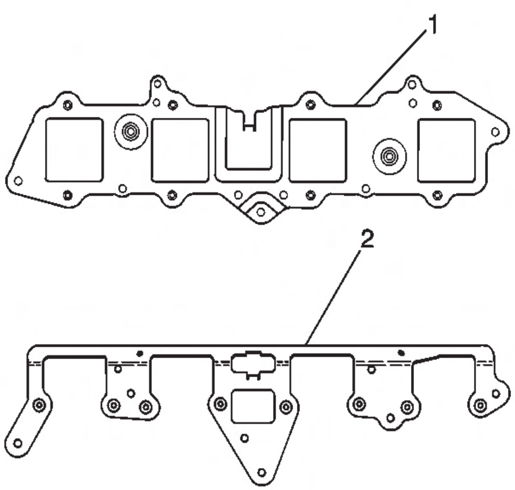
IMPORTANT:
The Melco® spark plug wires MUST be used only with the Melco® coils and bracket, like wise the Delphi® spark plug wires MUST be used only with Delphi® coils and bracket. The components are NOT interchange-able.

3. There are 2 different manufacturers for the spark plug wire, ignition coils and coil brackets. They are as follows:
4. The Melco® spark plug wire (1) will have a blue foil mark on it, and the wire is 145 mm (5.70 in) in length from cable seal to cable seal.

5. The Delphi® spark plug wire (2) will have a white foil mark on it, and the wire is 110 mm (4.30 in) in length cable seal to cable seal.



6. The Melco® (1) ignition coil is a square design.
7. The Delphi® (2) ignition coil is a round design.

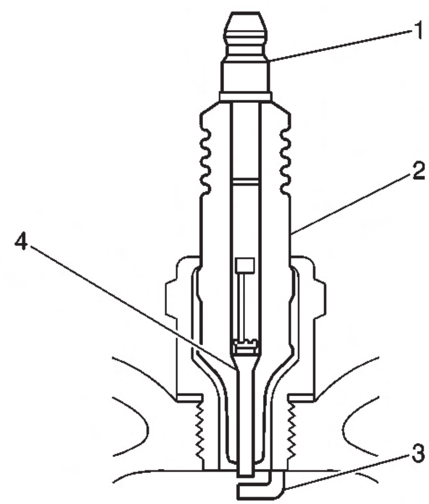


8. The Melco® ignition coil bracket (1) is a square design.
9. The Delphi® ignition coil bracket (2) is a round design.

Installation Procedure

1. Install the spark plug wire to the ignition coil.
2. Install the spark plug wire to the spark plug.
3. Inspect the spark plug wire for proper installation:
   A. Push sideways on each boot in order to inspect the seating.
   B. Reinstall any loose boot.

Spark Plug Inspection



- Verify that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to Ignition System Specifications for the correct spark plug.

- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
  - Spark plug fouling - Colder plug
  - Pre-ignition causing spark plug and/or engine damage - Hotter plug
- Inspect the terminal post (1) for damage.
  - Inspect for a bent or broken terminal post (1).
  - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should not move.
- Inspect the insulator (2) for flashover or carbon tracking, or soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
  - Inspect the spark plug boot for damage.
  - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated will cause arcing to ground.
- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).
- Inspect for evidence of improper arcing.
  - Measure the gap between the center electrode (4) and the side electrode (3). Refer to Ignition System Specifications. An excessively wide electrode gap can prevent correct spark plug operation.
  - Inspect for the correct spark plug torque. Refer to Ignition System Specifications. Insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
  - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
  - Inspect for a broken or worn side electrode (3).
  - Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
- A rattling sound indicates internal damage.
- A loose center electrode (4) reduces the spark intensity.
  - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
  - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
  - Inspect for excessive fouling.
- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

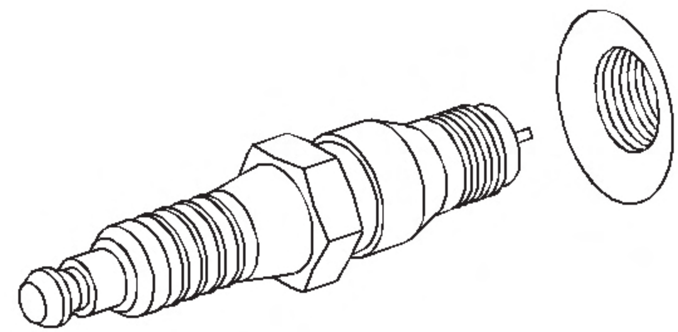
Visual Inspection

- Normal operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon fouled - Dry, fluffy black carbon, or soot caused by the following conditions:
- Rich fuel mixtures
- Leaking fuel injectors

- Excessive fuel pressure
- Restricted air filter element
- Incorrect combustion
  - Reduced ignition system voltage output
- Weak ignition coils
- Worn ignition wires
- Incorrect spark plug gap
  - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit fouling - Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark plug intensity. Most powdery deposits will not affect spark plug intensity unless they form into a glazing over the electrode.

Spark Plug Replacement

Removal Procedure



1. Remove the spark plug wire. Refer to Spark Plug Wire Replacement.
2. Loosen the spark plug 1 or 2 turns.
3. Brush or using compressed air, blow away any dirt from around the spark plug.
4. Remove the spark plug.

IMPORTANT:
If removing more than one plug, place each plug in a tray marked with the corresponding cylinder number.

Installation Procedure

1. Correctly position the spark plug washer.
2. Inspect the spark plug gap. Adjust the gap as needed.
   Specification
   Spark plug gap: 1.016 mm (0.040 in)

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

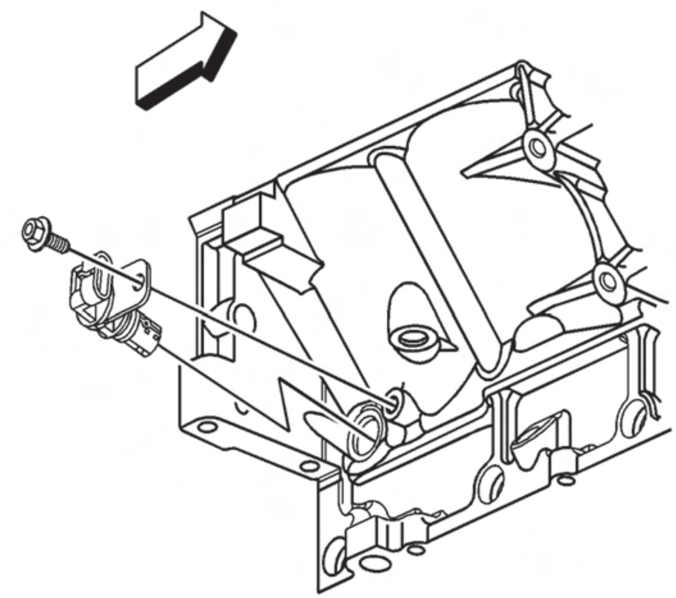
3. Hand start the spark plug in the corresponding cylinder.
4. Tighten the spark plug as follows:
   - Tighten the plug to 15 N·m (11 lb ft) for used heads.
   - Tighten the plug to 20 N·m (15 lb ft) for NEW heads.
5. Install the spark plug wire. Refer to Spark Plug Wire Replacement.

Crankshaft Position Sensor Replacement

Removal Procedure

IMPORTANT:
Perform the Crankshaft Position System Variation Learn whenever the crankshaft position sensor is removed or replaced.

1. Remove the starter.
2. Disconnect the crankshaft position (CKP) sensor electrical connector.



3. Clean the area around the CKP sensor before removal in order to avoid debris from entering the engine.
4. Remove the CKP sensor bolt.
5. Remove the CKP sensor.

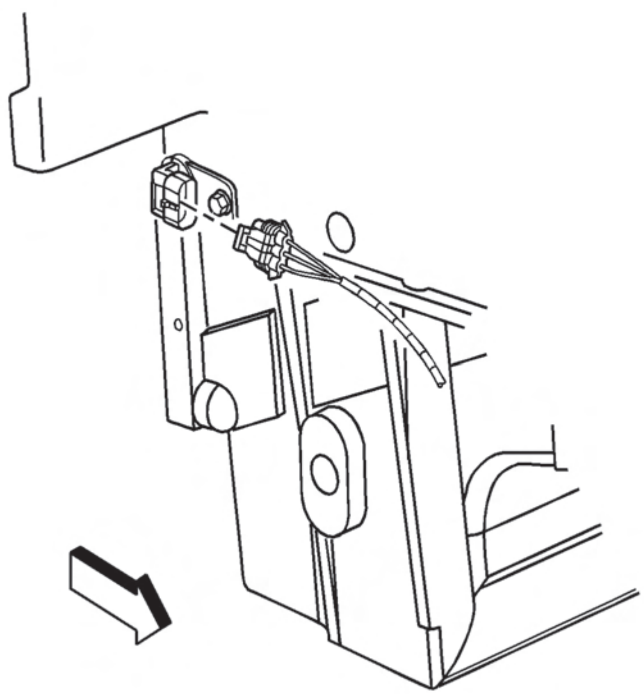
Installation Procedure

1. Install the CKP sensor.

NOTICE:

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the CKP sensor bolt and tighten the bolt to 25 n m (18 lb ft).



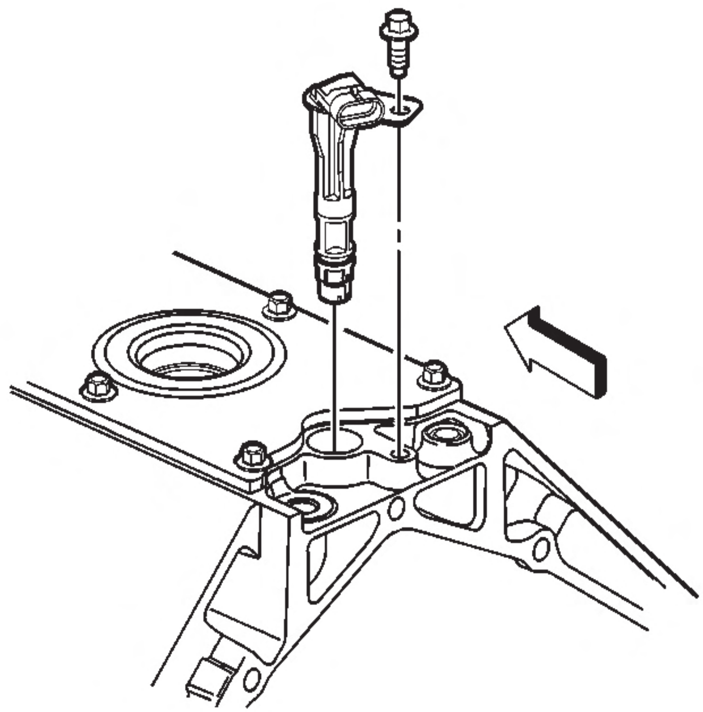
3. Connect the CKP sensor electrical connector.
4. Install the starter.
5. Perform the CKP system variation learn procedure. Refer to Crankshaft Position System Variation Learn.

Camshaft Position Sensor Replacement

Removal Procedure

IMPORTANT:

Clean the area around the camshaft position (CMP) sensor before removal in order to prevent debris from entering the engine.



1. Remove the CMP sensor bolt.
2. Remove the CMP sensor.

Installation Procedure

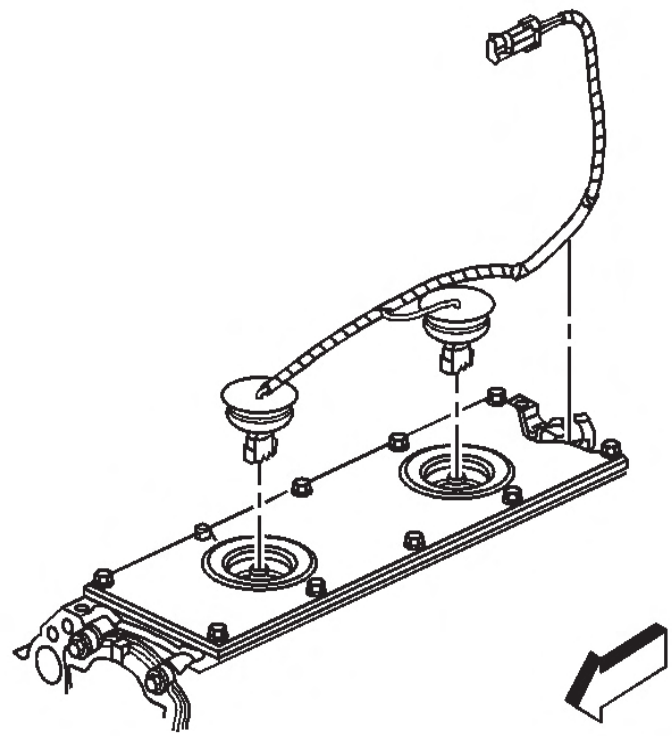
1. Install the CMP sensor.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

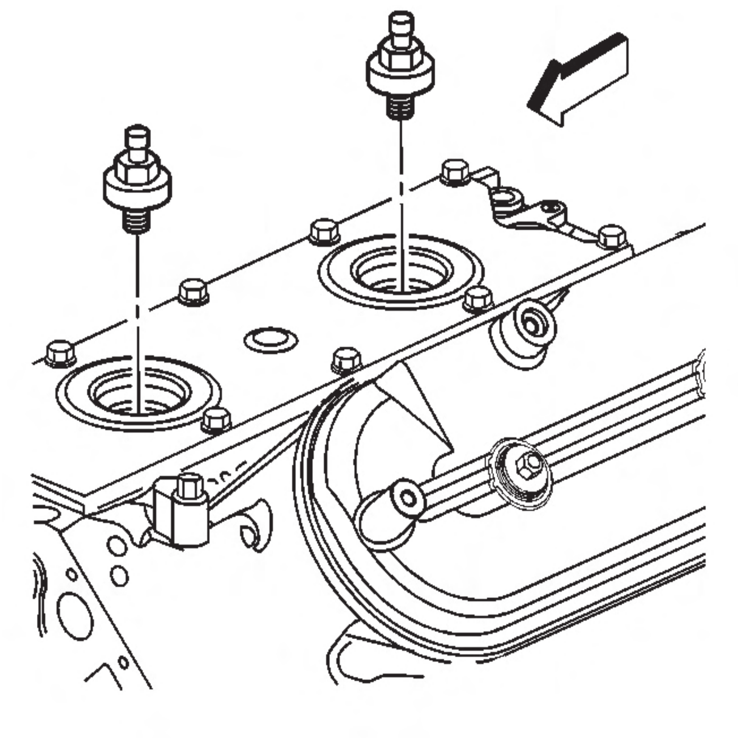
2. Install the CMP sensor bolt and tighten the bolt to 29 N•m (21 lb ft).

Knock Sensor Replacement

Removal Procedure



1. Remove the intake manifold. Refer to Intake Manifold Replacement.
2. Gently pry up the rubber covers.
3. Disconnect the knock sensor electrical connectors.



4. Remove the knock sensors.

Installation Procedure

NOTICE:

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

1. Install the knock sensors and tighten the sensor to 20 N•m (15 lb ft).
2. Connect the knock sensor electrical connectors.
3. Push down on the rubber covers.
4. Install the intake manifold. Refer to Intake Manifold Replacement.

8.1L ENGINES

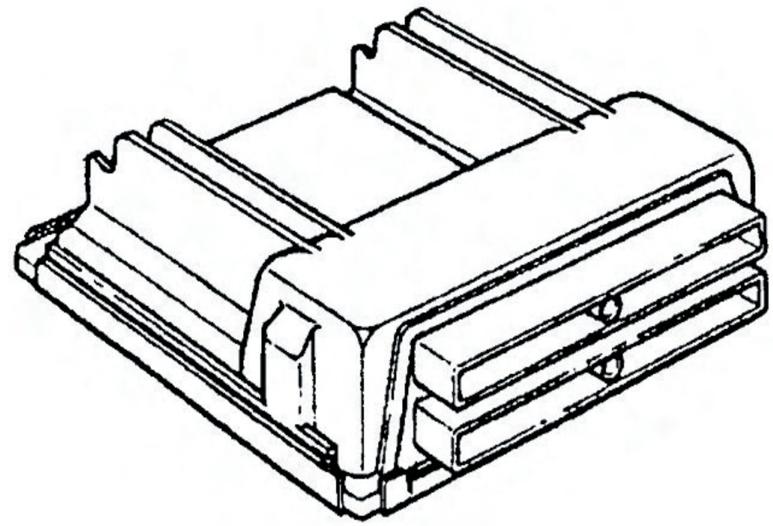
Powertrain Control Module Replacement

Service of the powertrain control module (PCM) should consist of either replacement of the PCM or programming of the electrically erasable programmable read only memory (EEPROM). If the diagnostic procedures call for the PCM to be replaced, the replacement PCM should be checked to ensure that the correct part is being used. If the correct part is being used, remove the faulty PCM and install the new service PCM.

NOTICE:

- *Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.*
- *Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.*
- *In order to prevent any possible electrostatic discharge damage to the control module, do no touch the connector pins or the soldered components on the circuit board.*
- *Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.*

Removal Procedure



1. Disconnect the negative battery cable.
2. Release the spring latch from the PCM.
3. Slide the PCM forward and rotate 90 degrees to access the PCM connectors.
4. Loosen the PCM electrical connector bolts.

NOTICE:

Do not touch the connector pins or soldered components on the circuit board in order to prevent possible electrostatic discharge (ESD) damage to the PCM.

NOTICE:
In order to prevent internal damage to the PCM, the ignition must be OFF when disconnecting or reconnecting the PCM connector.

5. Disconnect the PCM electrical connectors.
6. Release the PCM mounting tabs from the PCM.
7. Remove the PCM.

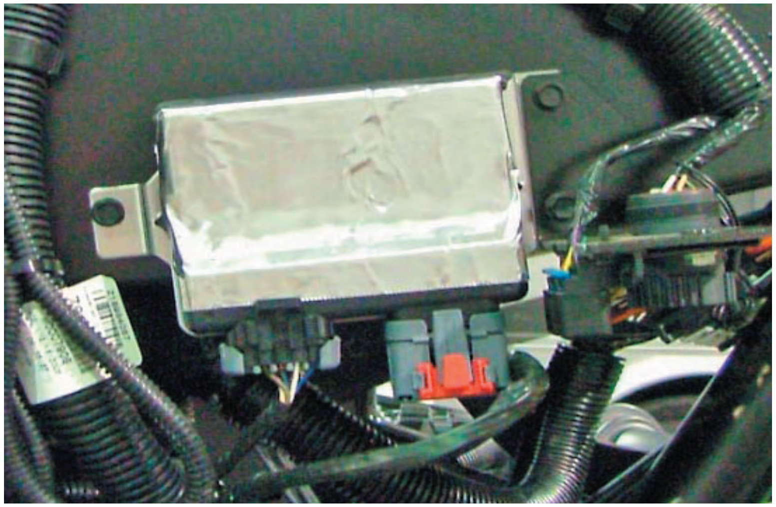
Installation Procedure

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

1. Connect the PCM electrical connectors.
2. Tighten the PCM electrical connector bolts to 8 N·m (71 lb in).
3. Position the PCM in the mounting tray and ensure that the mounting tabs are engaged.
4. Secure the spring latch to the PCM.
5. Connect the negative battery cable.

Throttle Actuator Control (TAC) Module Replacement

Removal Procedure



1. Disconnect the electrical connectors from the TAC module.
2. Remove the throttle actuator control (TAC) module nuts.
3. Remove the TAC module.

Installation Procedure

1. Install the TAC module.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the TAC module nuts and tighten the nuts to 1.9 N·m (17 lb in).
3. Install the TAC module connectors.

Crankshaft Position System Variation Learn

1. Install a scan tool.
2. Monitor the powertrain control module (PCM) for DTCs with a scan tool. If other DTCs are set, except DTC P0315, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC.
3. Select the crankshaft position variation learn procedure with a scan tool.
4. The scan tool instructs you to perform the following:
   - 4.1. Accelerate to wide open throttle (WOT).
   - 4.2. Release throttle when fuel cut-off occurs.
   - 4.3. Observe fuel cut-off for applicable engine.
   - 4.4. Engine should not accelerate beyond calibrated RPM value.
   - 4.5. Release throttle immediately if value is exceeded.
   - 4.6. Block drive wheels.
   - 4.7. Set parking brake.
   - 4.8. DO NOT apply brake pedal.
   - 4.9. Cycle ignition from OFF to ON.
   - 4.10. Apply and hold brake pedal.
   - 4.11. Start and idle engine.
   - 4.12. Turn the A/C OFF.
   - 4.13. Vehicle must remain in Park or Neutral.
   - 4.14. The scan tool monitors certain component signals to determine if all the conditions are met to continue with the procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool monitors the following components:
     - Crankshaft position (CKP) sensors activity--If there is a CKP sensor condition, refer to the applicable DTC.
     - Camshaft position (CMP) signal activity--If there is a CMP signal condition, refer to the applicable DTC.
     - Engine coolant temperature (ECT)--If the engine coolant temperature is not warm enough, idle the engine until the engine coolant temperature reaches the correct temperature.
5. Enable the CKP system variation learn procedure with the scan tool.

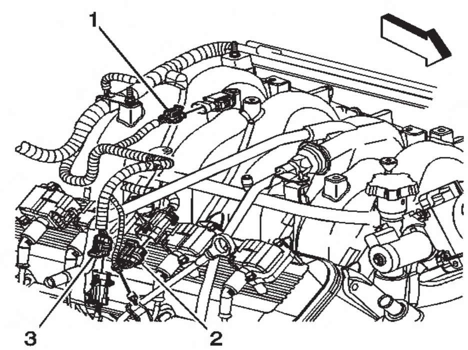
IMPORTANT:
While the learn procedure is in progress, release the throttle immediately when the engine starts to decelerate. The engine control is returned to the operator and the engine responds to throttle position after the learn procedure is complete.

6. Accelerate to WOT.
7. Release throttle when fuel cut-off occurs.
8. The scan tool display reads Test In Progress.
9. The scan tool displays Learn Status: Learned this ignition. If the scan tool indicates that DTC P0315 ran and passed, the CKP variation learn procedure is complete. If the scan tool indicates DTC P0315 failed or did not run, refer to DTC P0315 . If any other DTCs set, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC.
10. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.
11. The CKP system variation learn procedure is also required when the following service procedures have been performed, regardless of whether or not DTC P0315 is set:
    - An engine replacement
    - A PCM replacement
    - A harmonic balancer replacement
    - A crankshaft replacement
    - A CKP sensor replacement
    - Any engine repairs which disturb the crankshaft to CKP sensor relationship.

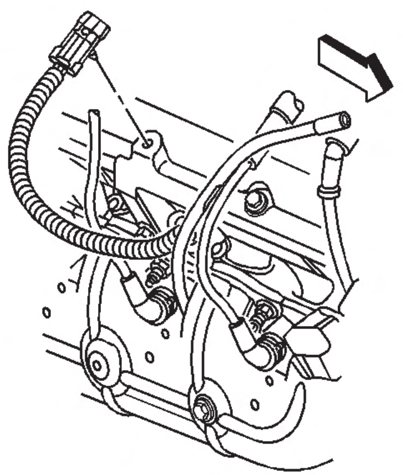
Engine Coolant Temperature Sensor Replacement

Removal Procedure

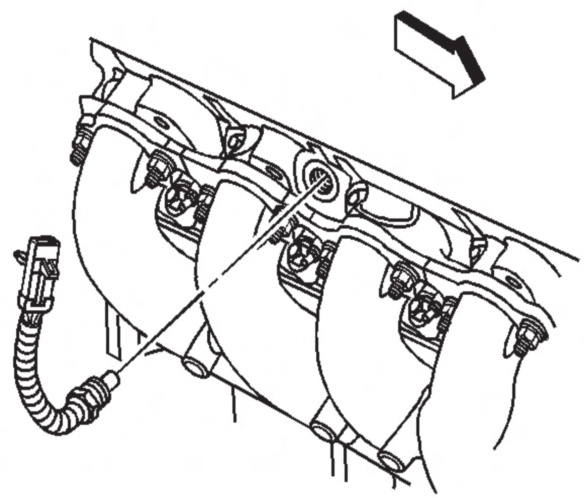
NOTICE:
Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.



1. Drain the cooling system to a level below the engine coolant temperature (ECT) sensor. .
2. Disconnect the ECT sensor electrical connector (3).



3. Remove the ECT sensor electrical connector from the oil fill tube bracket.



4. Remove the ECT sensor.

Installation Procedure

1. If installing the old sensor, coat the threads with sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the ECT sensor and tighten the sensor to 50 N·m (37 lb ft).
3. Install the ECT sensor electrical connector to the oil fill tube bracket.
4. Connect the ECT sensor electrical connector (3).
5. Refill the cooling system.

Mass Airflow Sensor/Intake Air Temperature Sensor Replacement

Removal Procedure

IMPORTANT:

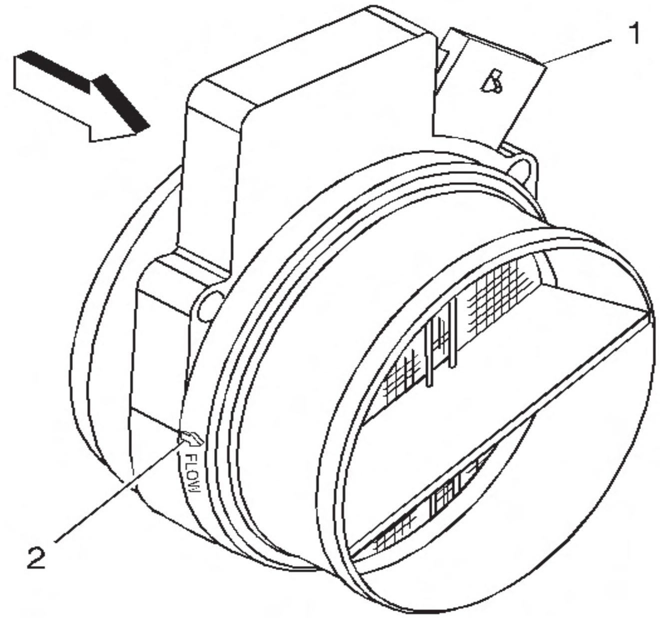
Use care when handling the mass air flow(MAF)/intake air temperature (IAT) sensor. Do not dent, puncture, or otherwise damage the honeycell located at the air inlet end of the MAF/IAT. Do not touch the sensing elements or allow anything including cleaning solvents and lubricants to come in contact with them. Use a small amount of a non-silicone based lubricant, on the air duct only, to aid in installation.

1. Disconnect the MAF/IAT sensor electrical connector.
3. Loosen the MAF/IAT clamps.
4. Remove the MAF/IAT sensor from the air cleaner assembly.

Installation Procedure

IMPORTANT:

The embossed arrow on the MAF/IAT sensor indicates the proper air flow direction. The arrow must point toward the engine.



1. Locate the air flow direction arrow (2) on the MAF/IAT sensor.

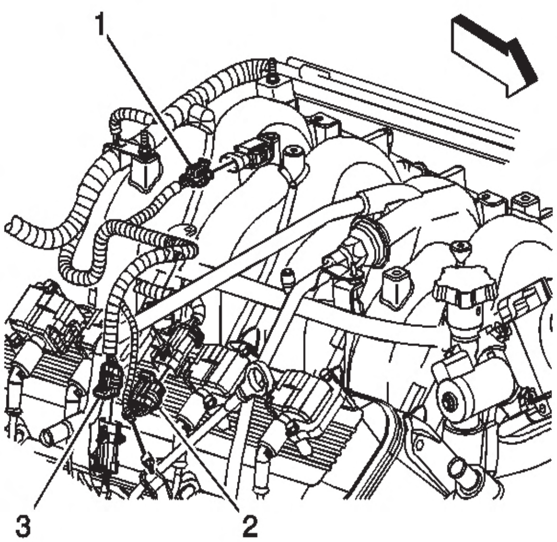
NOTICE:

Refer to Fastener Notice in Cautions and Notices.

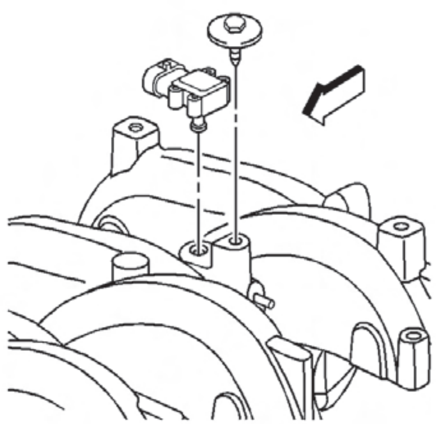
2. Install the MAF/IAT sensor to the air cleaner assembly.
3. Tighten the MAF/IAT clamp to 7 N·m (62 lb in).
4. Connect the MAF/IAT sensor electrical connector (3).
5. Install the air intake resonator.

Manifold Absolute Pressure Sensor Replacement

Removal Procedure



1. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).



2. Remove the MAP sensor bolt.
3. Remove the MAP sensor.
4. Inspect the MAP sensor seal for wear or damage, replace as necessary.

Installation Procedure

IMPORTANT:
Lubricate the port of the MAP sensor with clean engine oil. Avoid dipping the sensor port directly into the lubricant or using a solid type of lubricant, as they may block the vacuum port signal.

1. Install the MAP sensor.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the MAP sensor bolt and tighten the bolt to 12 N•m (106 lb in).
3. Connect the MAP sensor electrical connector (1).
4. Install the engine sight shield.

Heated Oxygen Sensor Replacement

Removal Procedure

1. Raise and suitably support the vehicle.
2. Disconnect the connector position assurance (CPA) retainer.

NOTICE:

Do not remove the pigtail from either the heated oxygen sensor (HO2S). Removing the pigtail or the connector will affect sensor operation.

NOTICE

Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged.

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- *Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.*
- *Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.*
- *Ensure the sensor or vehicle lead wires are not bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead wire.*
- *Do not remove or defeat the oxygen sensor ground wire, where applicable. Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.*
- *Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.*

3. If the heated oxygen sensor (HO2S) pigtail or harness is attached to another component, disconnect the clip.
4. Disconnect the HO2S electrical connector.
5. Remove the HO2S.

Installation Procedure

IMPORTANT:
A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

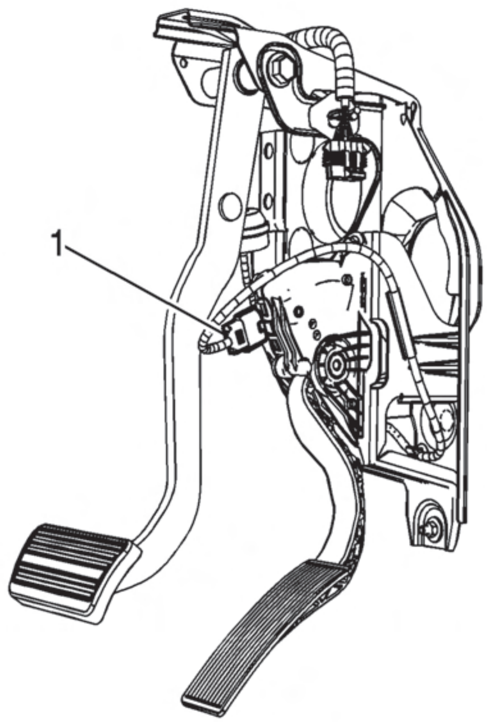
NOTICE:
Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

2. Install the HO2S and tighten to 42 N·m (31 lb ft).
3. Connect the HO2S electrical connector.
4. If the heated oxygen sensor (HO2S) pigtail or harness was attached to another component, connect the pigtail or harness of the new sensor to that component using the clip.
5. If necessary, bolt the front propeller shaft to the front differential.
6. Lower the vehicle.

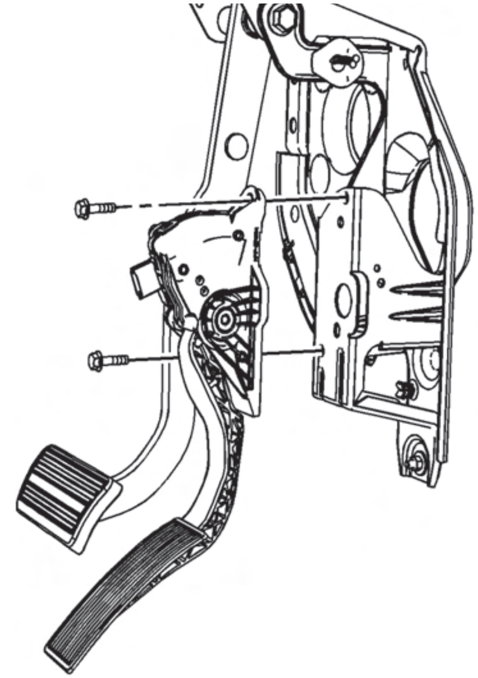
Accelerator Pedal Position Sensor Replacement

Removal Procedure

NOTICE:
Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.



1. Remove the connector position assurance (CPA) retainer.
2. Disconnect the accelerator pedal position (APP) sensor electrical connector (1).



3. Remove the accelerator pedal bolts.
4. Remove the accelerator pedal.

Installation Procedure

1. Position the accelerator pedal to the accelerator pedal bracket.

NOTICE:
Refer to Fastener Notice in Cautions and Notices.

2. Install the accelerator pedal bolts tighten the bolts to 9 N·m (80 lb in).
3. Connect the APP sensor electrical connector (1).
4. Install the CPA retainer.
5. Connect a scan tool to the diagnostic port in order to test for proper throttle-opening and throttle-closing range.

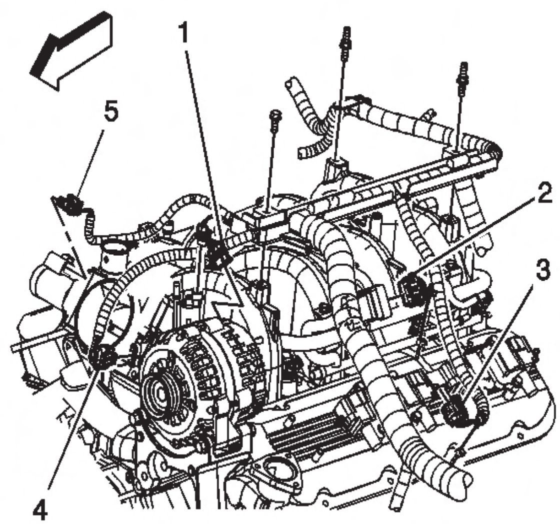
6. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
7. Verify that the vehicle meets the following conditions:
   - The vehicle is not in a reduced engine power mode.
   - The ignition is ON.
   - The engine is OFF.
8. Inspect the carpet fit under the accelerator pedal.

Throttle Body Assembly Replacement

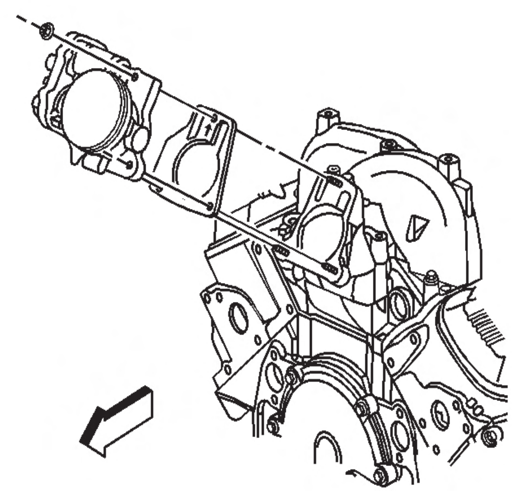
Removal Procedure

NOTICE:
Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.

IMPORTANT:
An 8-digit part identification number is stamped on the throttle body casting. Refer to this number if servicing, or part replacement is required.



1. Remove the intake air resonator.
2. Disconnect the throttle actuator motor electrical connector (5).



IMPORTANT:
Cover or plug any openings when servicing the throttle body in order to prevent possible contamination.

3. Remove the throttle body nuts.
4. Remove the throttle body.
5. Remove and discard the throttle body gasket.

Installation Procedure

1. Install a NEW throttle body gasket.
2. Install the throttle body.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

3. Install the throttle body nuts tighten the nuts to 10 N·m (89 lb in).
4. Connect the TAC motor electrical connector.
5. Install the intake air resonator.
6. Connect a scan tool in order to test for proper throttle-opening and throttle-closing range.
7. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
8. Verify that the vehicle meets the following conditions:
   - The vehicle is not in a reduced engine power mode.
   - The ignition is ON.
   - The ignition is OFF.

Throttle Body Cleaning

1. Remove the intake air resonator.
2. Inspect the throttle body bore and the throttle body plate for deposits. You will need to open the throttle plate in order to inspect all surfaces.
3. Clean the throttle body bore and the throttle plate using a clean shop towel with GM top engine cleaner, P/N 1052626 or AC Delco Carburetor Tune-up Conditioner, P/N X66P, or equivalent product.
4. Install the intake air resonator.

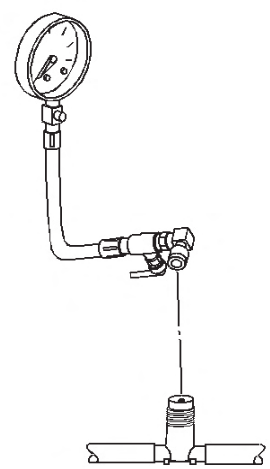
Fuel Pressure Relief

Tools Required

- J 34730-1A Fuel Pressure Gage

CAUTION:

Relieve the fuel system pressure before servicing fuel system components in order to reduce the risk of fire and personal injury. After relieving the system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. In order to reduce the chance of personal injury, cover the regulator and the fuel line fittings with a shop towel before disconnecting. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.



1. Disconnect the negative battery cable.
2. Install the J 34730-1A . Refer to Fuel Pressure Gage Installation and Removal .
3. Loosen the fuel fill cap in order to relieve fuel tank vapor pressure.
4. Open the valve on the J 34730-1A in order to bleed the system pressure. The fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gage into an approved container.
6. Once the system pressure is completely relieved, remove the J 34730-1A . Refer to Fuel Pressure Gage Installation and Removal .

Fuel Pressure Gage Installation and Removal

Tools Required

- J 34730-1A Fuel Pressure Gage

Installation Procedure

CAUTION:

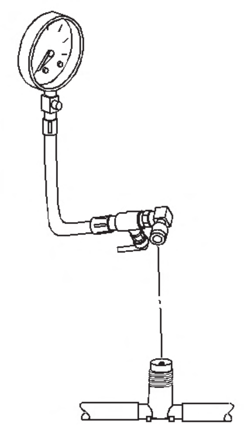
Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

CAUTION:

Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gage. Place the towel in an approved container when the connection of the fuel pressure gage is complete.

1. Remove the fuel rail pressure cap.
2. Connect the J 34730-1A to the fuel pressure valve. Wrap a shop towel around the fitting while connecting the gage in order to avoid spillage.
3. Install the bleed hose on J 34730-1A into an approved container.

Removal Procedure



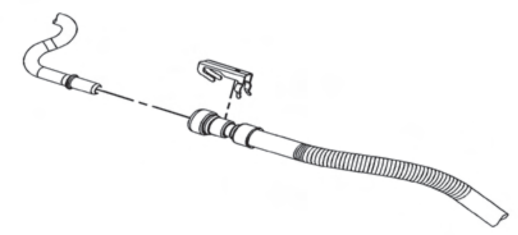
1. Remove the bleed hose on the J 34730-1A from the approved container.
2. Remove the shop towel from around the fitting and discard into an approved container.
3. Disconnect the J 34730-1A from the fuel pressure valve.
4. Install the fuel rail pressure fitting cap.

Metal Collar Quick Connect Fitting Service

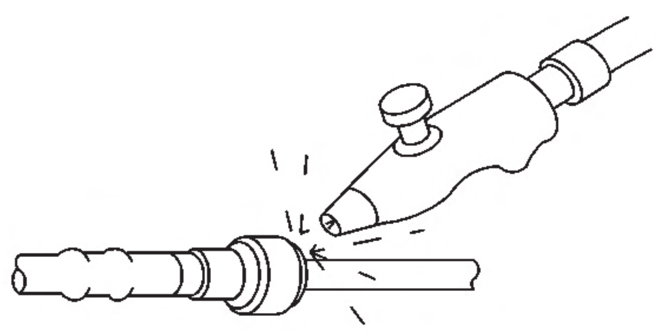
Tools Required

- J 41769 Fuel Line Quick Disconnect Tool
- J 43178 Fuel Line Disconnect Tool

Removal Procedure



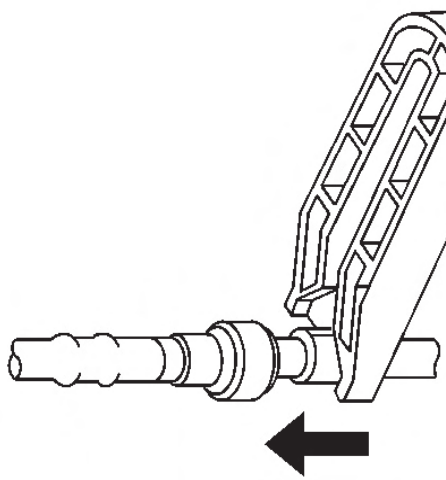
1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .
2. Remove the retainer from the fuel feed line to engine quick-connect fitting.



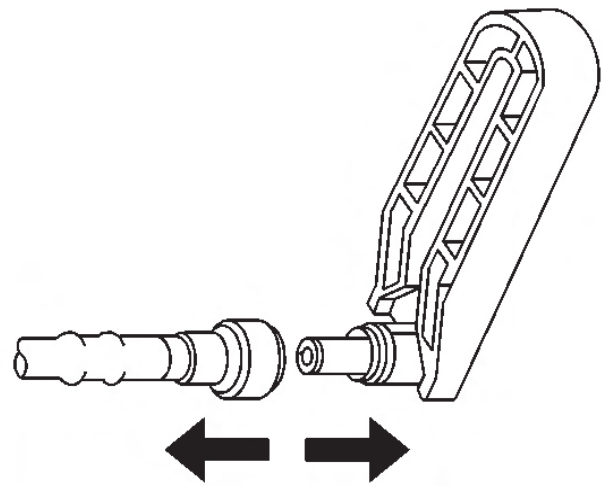
CAUTION:

Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Using compressed air, blow any dirt or debris from around the fitting.



4. Using the correct tool from J 41769 , insert the tool into the female connector, then push inward in order to release the quick connect locking tabs.



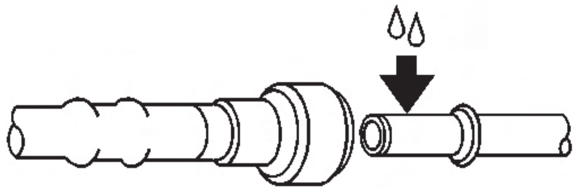
5. Pull the fuel line connection apart.

NOTICE:

If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. Use a clean shop towel in order to wipe off the male connection end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.

Installation Procedure



CAUTION:

In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.This will ensure proper reconnection and prevent a possible fuel leak.During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

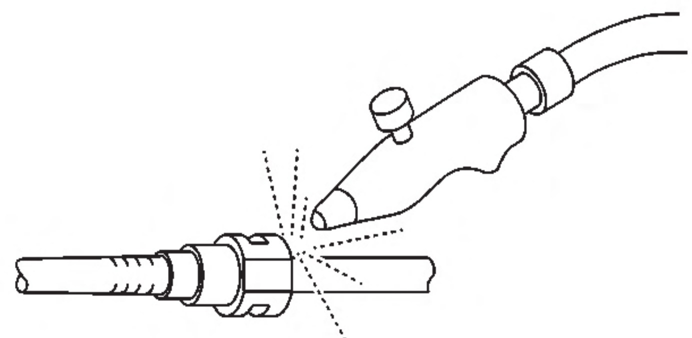
1. Apply a few drops of clean engine oil to the male connection end.
2. Push both sides of the fittings together in order to snap the retaining tabs into place.
3. Once installed, pull on both sides of the connection in order to make sure the connection is secure.
4. Install the retainer to the fuel feed line quick-connect fitting.
5. Install the fuel fill cap.
6. Connect the negative battery cable.

Plastic Collar Quick Connect Fitting Service

Removal Procedure

IMPORTANT:

There are several types of plastic fuel and evaporative emission (EVAP) quick connect fittings used on this vehicle. The following instructions apply to all types of plastic quick connect fittings except where indicated.

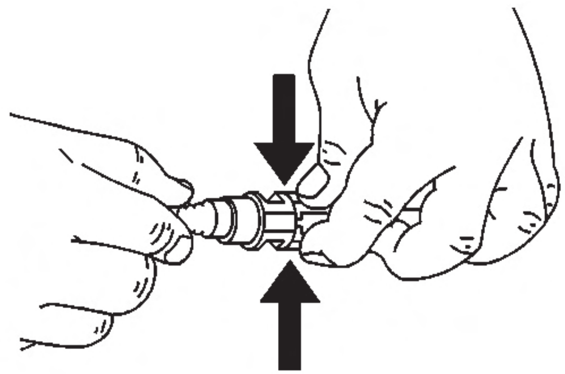


1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .

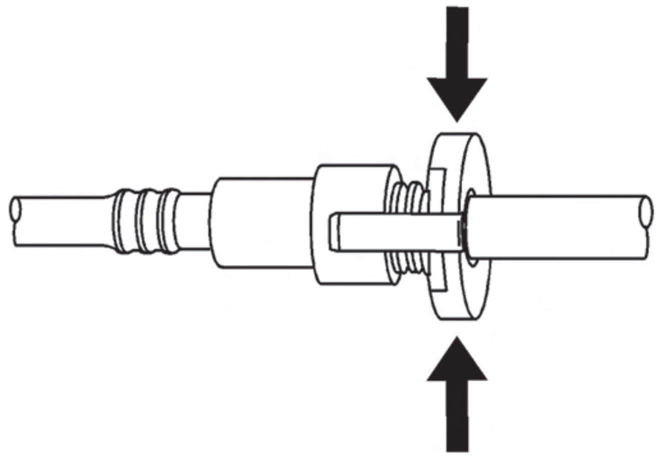
CAUTION:

Wear safety glasses when using compressed air in order to prevent eye injury.

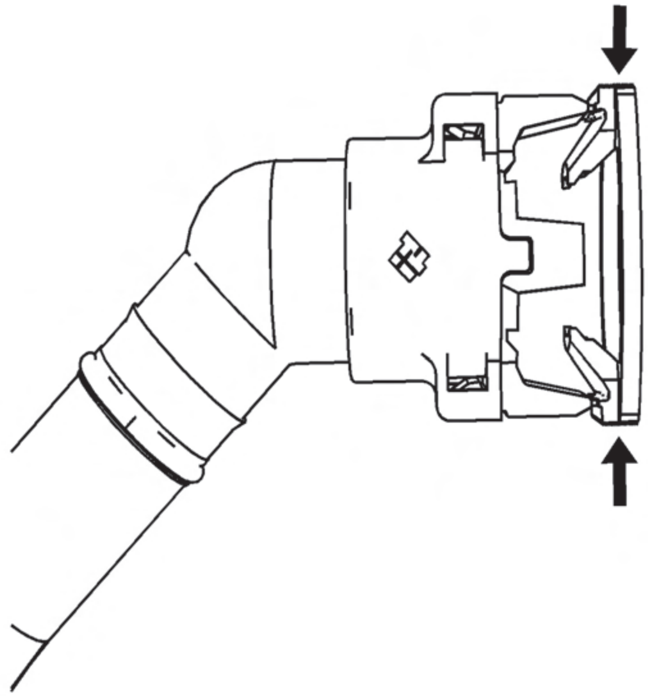
2. Using compressed air, blow any dirt or debris from around the quick connect fitting.



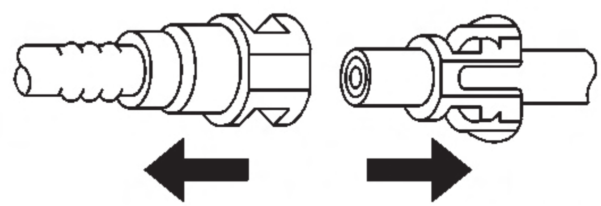
3. Squeeze the plastic quick connect fitting release tabs together to disengage the quick connect fitting. (This step applies to Bartholomew style fittings ONLY)



4. Squeeze where indicated by the arrows on both sides of the plastic ring to disengage the quick connect fitting.



5. Squeeze where indicated by the arrows on both sides of the plastic ring to disengage the quick connect fitting.



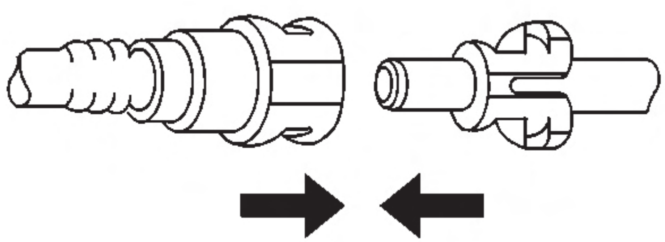
6. Pull the quick connect fitting connection apart.

Installation Procedure

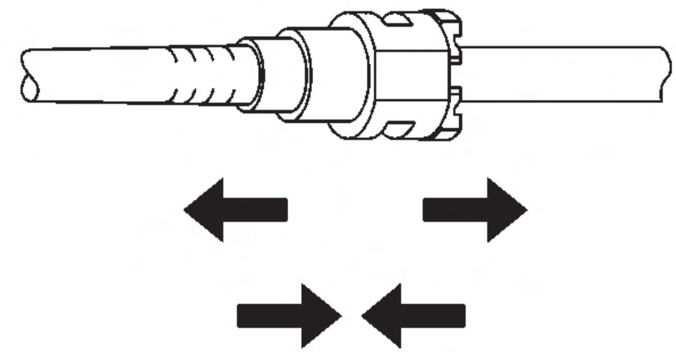
CAUTION:

In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.This will ensure proper reconnection and prevent a possible fuel leak.During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male connection end.



2. Push both sides of the quick-connect fitting together in order to cause the retaining tabs to snap into place.



3. Once installed, pull on both sides of the quick-connect fittings in order to make sure the connection is secure.

Fuel Tank Draining

Tools Required

- J 45004 Fuel Tank Siphon Hose

CAUTION:

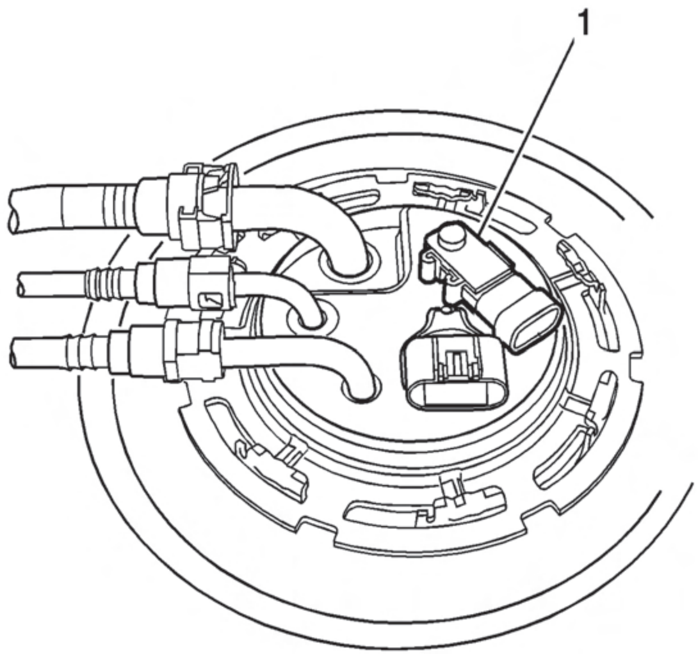
Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

1. Remove the fuel fill cap.
2. Insert the adapter to the fill pipe in order to hold open the internal fill pipe door.
3. Insert the J 45004 hose through the adapter and into the tank.
4. Attach the J 45004 hose to the hose used with the hand or air operated pumping device.

5. Using the hand or air operated pumping device, drain as much fuel from the tank as possible.

Fuel Tank Pressure Sensor Replacement

Removal Procedure



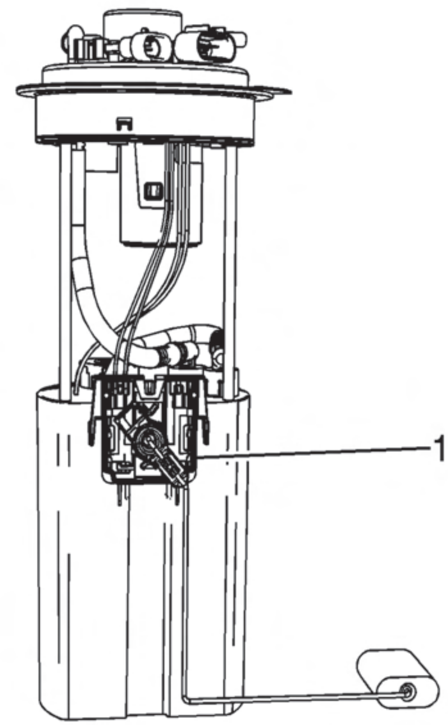
1. Remove the fuel tank.
2. Using a slight rocking motion, while pulling straight up, remove the fuel tank pressure sensor (1).

Installation Procedure

1. Install the fuel tank pressure sensor (1).
2. Install the fuel tank.

Fuel Level Sensor Replacement

Removal Procedure



1. Remove the sending unit. Refer to Fuel Sender Assembly Replacement .
2. Disconnect the fuel pump electrical connector.
3. Remove the fuel lever sensor electrical connector retaining clip.
4. Disconnect the fuel level sensor electrical connector.
5. Remove the fuel level sensor retaining clip.
6. Remove the fuel level sensor (1).

Installation Procedure

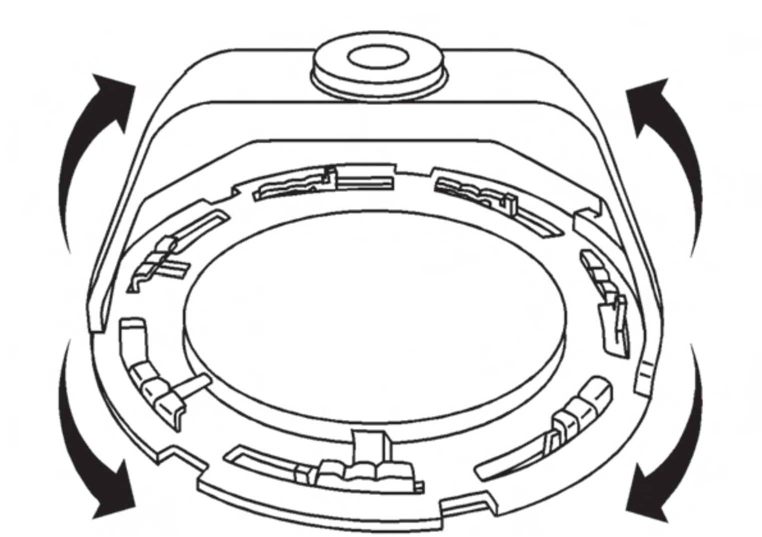
1. Install the fuel level sensor (1).
2. Install the fuel level sensor retaining clip.
3. Connect the fuel level sensor electrical connector.
4. Install the fuel lever sensor electrical connector retaining clip.
5. Connect the fuel pump electrical connector.
6. Install the sending unit. Refer to Fuel Sender Assembly Replacement .

Fuel Sender Assembly Replacement

Tools Required

- J 45722 Fuel Sender Lock Ring Wrench

Removal Procedure



1. Remove the fuel tank.
2. Disconnect the fuel line from the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar) .
3. Disconnect the evaporative emission (EVAP) line from the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar) .

CAUTION:

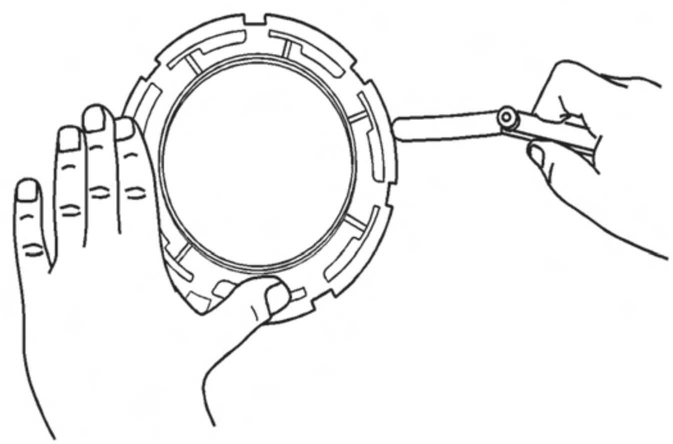
Drain the fuel from the fuel sender assembly into an approved container in order to reduce the risk of fire and personal injury. Never store the fuel in an open container.

NOTICE:
Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

NOTICE:
Do Not handle the fuel sender assembly by the fuel pipes. The amount of leverage generated by handling the fuel pipes could damage the joints.

IMPORTANT:
Do NOT use impact tools. Significant force will be required to release the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

4. Use the J 45722 and a long breaker-bar in order to unlock the fuel sender lock ring.
5. Remove the sending unit and seal. Discard the seal.
6. Clean the sending unit sealing surfaces.



IMPORTANT:

- Some lock rings were manufactured with “DO NOT REUSE” stamped into them. These lock rings may be reused if they are not damaged or warped.
- Inspect the lock ring for damage due to improper removal or installation procedures. If damage is found, install a NEW lock ring.
- Check the lock ring for flatness.

7. Place the lock ring on a flat surface. Measure the clearance between the lock ring and the flat surface using a feeler gage at 7 points.
8. If warpage is less than 0.41 mm (0.016 in), the lock ring does not require replacement.
9. If warpage is greater than 0.41 mm (0.016 in), the lock ring must be replaced.

Installation Procedure

CAUTION:

In order to reduce the risk of fire and personal injury that may result from a fuel leak, always replace the fuel sender gasket when reinstalling the fuel sender assembly.

IMPORTANT:

The fuel strainer must be in a horizontal position when installing the sending unit is installed in the tank. When installing the sending unit, assure that the fuel strainer does not block full travel of the float arm.

1. Install a NEW sending unit seal.
2. Install the sending unit.

IMPORTANT:

Always replace the fuel sender seal when installing the fuel sender assembly. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

Ensure the lock ring is installed with the correct side facing upward. A correctly installed lock ring will only turn in a clockwise direction.

3. Use the J 45722 in order to install the fuel sender lock ring. Turn the fuel sender lock ring in a clockwise direction.
4. Connect the EVAP line to the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar) .
5. Connect the fuel line to the sending unit. Refer to Quick Connect Fitting(s) Service (Plastic Collar) .
6. Install the fuel tank.

Fuel System Cleaning

IMPORTANT:

- Only use oil free compressed air to blow out the fuel pipes.
- Inspect the fuel tank internally and clean the fuel tank if you find a plugged fuel filter.

CAUTION:

Before servicing any electrical component, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Remove the sending unit. Refer to Fuel Sender Assembly Replacement .
2. Inspect the fuel strainer. Replace a contaminated strainer and inspect the fuel pump.
3. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet.

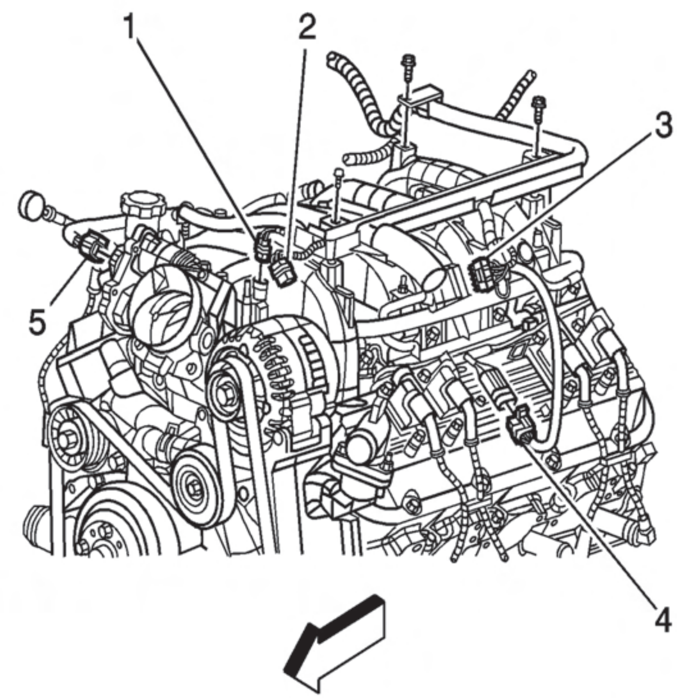
IMPORTANT:
When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water mixture in accordance with all applicable local, state, and federal laws and regulations.

4. Flush the fuel tank with hot water.
5. Pour the water out of the sending unit opening. Rock the tank to be sure that removal of the water from the tank is complete.
6. Install the sending unit. Refer to Fuel Sender Assembly Replacement .

Fuel Injection Fuel Rail Assembly Replacement

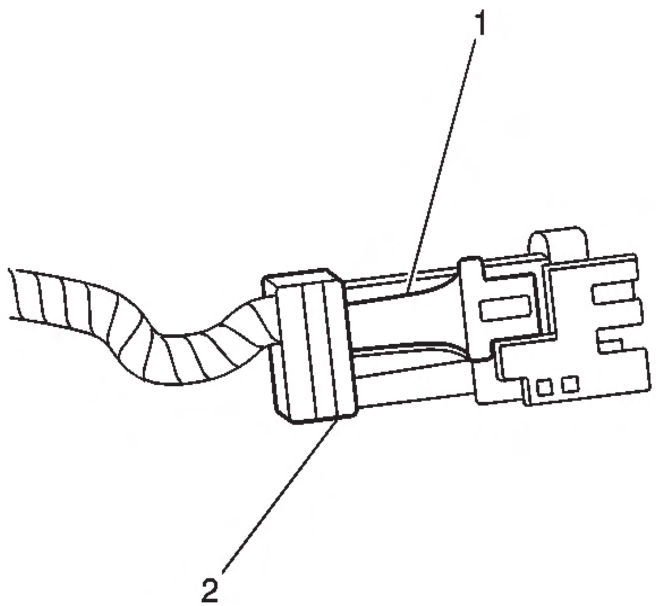
Removal Procedure

IMPORTANT:
An 8-digit identification number is located on the fuel rail. Refer to this number if servicing, or part replacement is required.

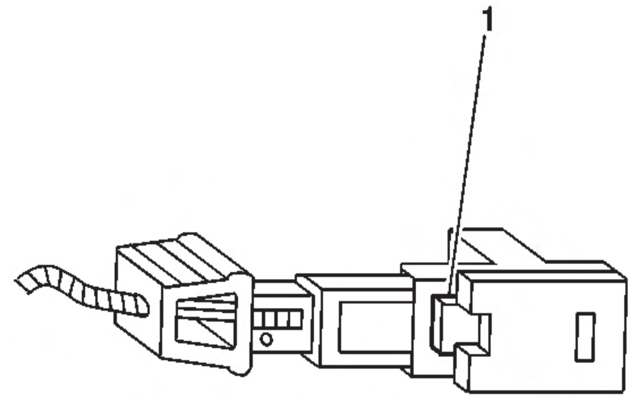


1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .

2. Remove the engine sight shield.
3. Disconnect the generator electrical connector (2).
4. Disconnect the evaporative emission (EVAP) canister purge valve electrical connector.
5. Disconnect the electronic throttle control (ETC) electrical connector (5).
6. Remove the engine harness bolt and studs.
7. Reposition the engine harness to the drivers side of the engine compartment.



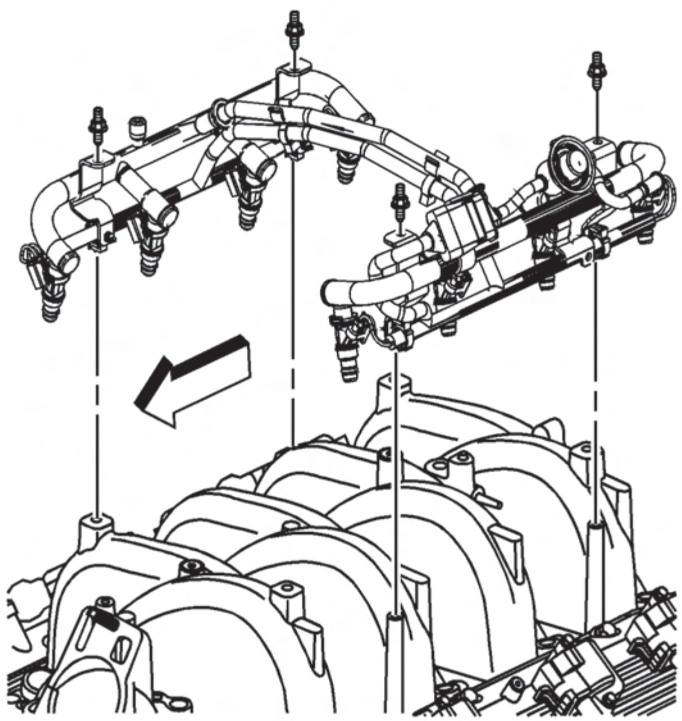
8. Identify the fuel injector connectors to their corresponding injectors in order to ensure correct sequential injector firing order after reassembly.
9. Pull the top portion (2) of the connector up. Do not pull the top portion of the connector past the top of the white portion (1).

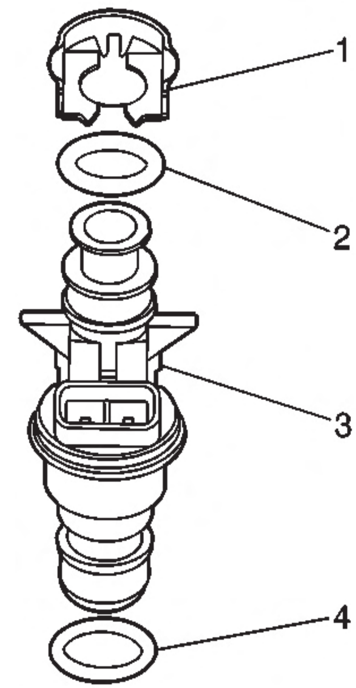


10. Push the tab (1) on the lower side of the connector in order to release the connector from the injector.
11. Repeat step 12 and step 13 for each injector connector.

NOTICE:
- *Remove the fuel rail assembly carefully in order to prevent damage to the injector electrical connector terminals and the injector spray tips. Support the fuel rail after the fuel rail is removed in order to avoid damaging the fuel rail components.*
- *Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering open pipes and passages.*

12. Disconnect the fuel feed (1) line from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service .





13. Remove the fuel rail studs.

IMPORTANT:
Before removal, clean the fuel rail with a spray type engine cleaner such as, GM X-30A or equivalent, if necessary. Follow the package instructions. Do not soak the fuel rails in liquid cleaning solvent.

14. Remove the fuel rail.

15. Remove and discard the fuel injector lower O-ring seals (4) from the spray tip end of each injector (3).

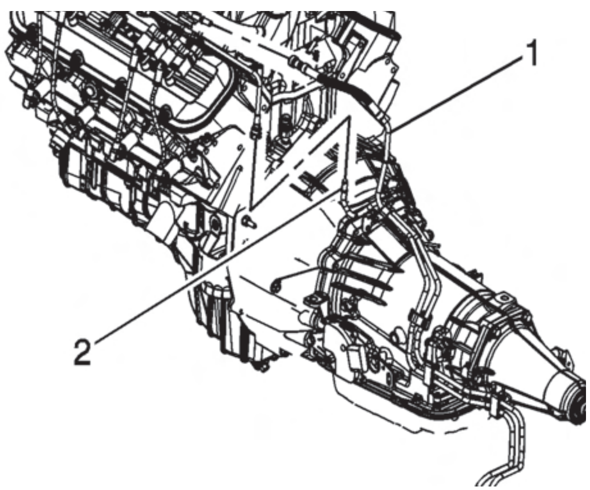
Installation Procedure

1. Lubricate NEW lower injector O-ring seals (4) with clean engine oil.
2. Install the NEW O-ring seals (4) onto the spray tip end of each injector (3).
3. Install the fuel rail.

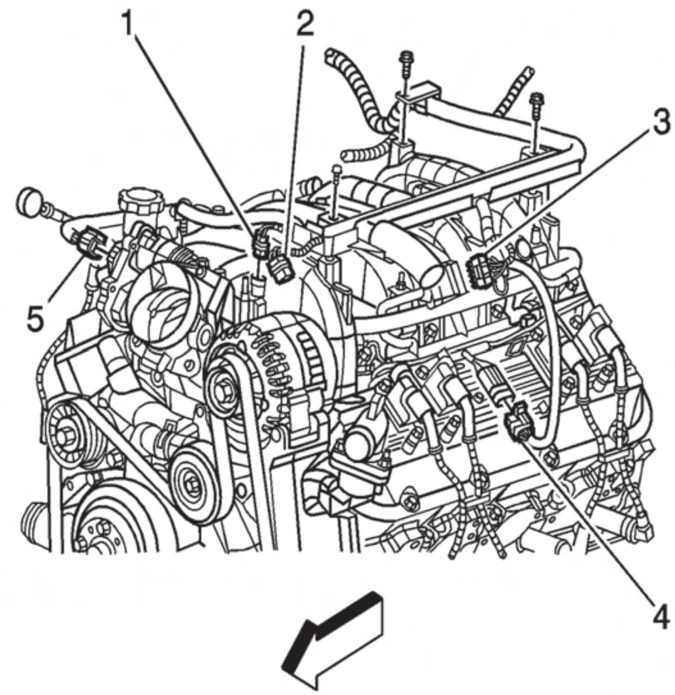
NOTICE:

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

4. Install the fuel rail studs and tighten the studs to 12 N·m (106 lb in).



5. Connect the fuel feed (1) line to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service .
6. Connect the fuel injector electrical connectors.
   - Install each connector onto the proper injector in order to ensure correct sequential injector firing order.
   - Rotate the injectors as required in order to avoid stretching the wire harness.

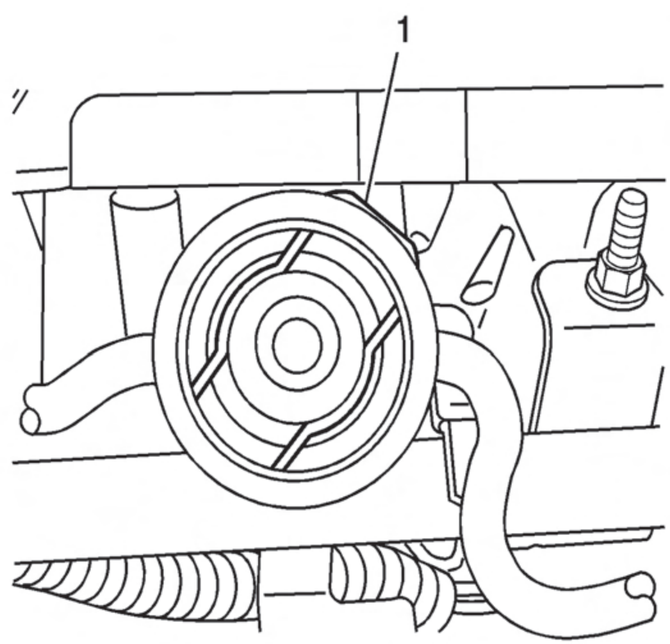


7. Reposition the engine harness.
8. Install the engine harness bolt and studs and tighten the bolt/studs to 10 N·m (89 lb in).
9. Connect the ETC electrical connector (5).
10. Connect the EVAP canister purge valve electrical connector.
11. Connect the generator electrical connector (2).
12. Install the engine sight shield.
13. Install the fuel fill cap.
14. Connect the negative battery cable.
15. Use the following procedure to inspect for leaks:

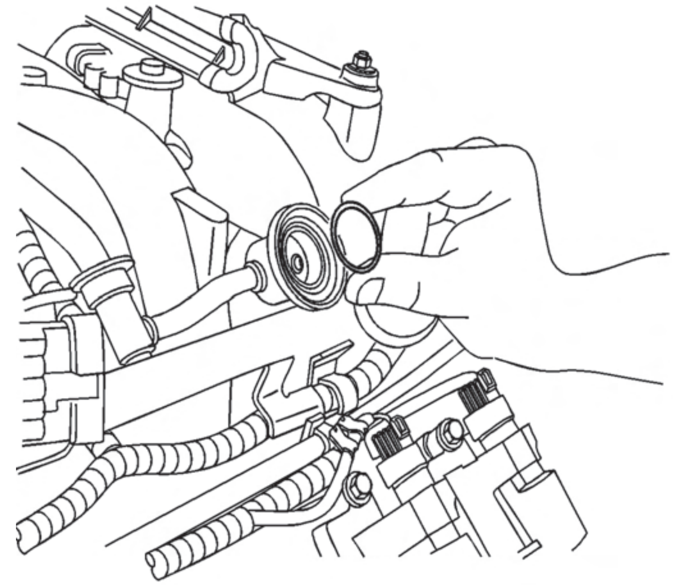
15.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
15.2. Turn the ignition OFF for 10 seconds.
15.3. Turn the ignition ON, with the engine OFF.
15.4. Inspect for fuel leaks.

Fuel Pulse Dampener Replacement

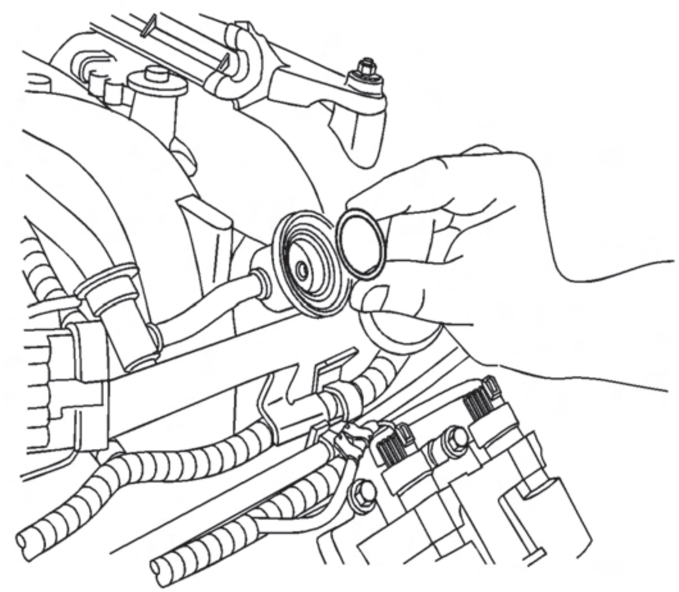
Removal Procedure



1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .
2. Clean any dirt from the fuel pressure dampener retainer and the surrounding area.
3. Remove the fuel pressure dampener clip (1) and dampener.



4. Remove the fuel pressure dampener backup ring.



5. Remove the fuel pressure dampener O-ring.

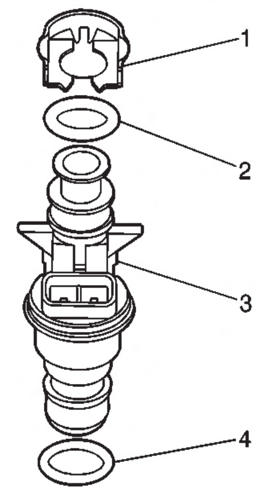
Installation Procedure

1. Lubricate the fuel pressure dampener O-ring with clean engine oil.
2. Install the fuel pressure dampener O-ring.
3. Install the fuel pressure dampener backup ring.
4. Install the fuel pressure dampener and clip (1).
5. Install the fuel fill cap.
6. Connect the negative battery cable.
7. Use the following procedure to inspect for leaks:
   - 7.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
   - 7.2. Turn the ignition OFF for 10 seconds.
   - 7.3. Turn the ignition ON, with the engine OFF.
   - 7.4. Inspect for fuel leaks.

Fuel Injector Replacement

Removal Procedure

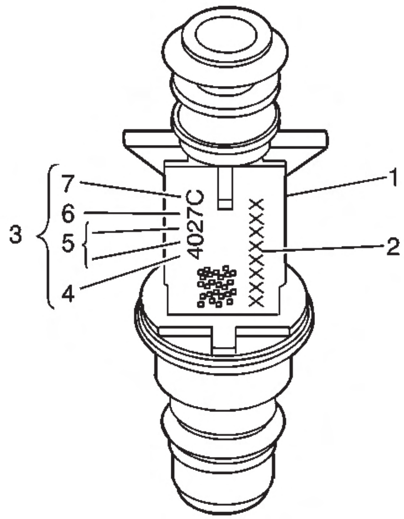
NOTICE:
Use care in removing the fuel injectors in order to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. Do not immerse the fuel injector in any type of cleaner. The fuel injector is an electrical component and may be damaged by this cleaning method.



IMPORTANT:
The engine oil may be contaminated with fuel if the fuel injectors are leaking.

1. Remove the fuel rail. Refer to Fuel Rail Assembly Replacement .
2. Remove and discard the fuel injector retaining clip (1).
3. Remove the injector (5) from the fuel rail.
4. Remove and discard the injector O-ring seals (2, 4) from both ends of the injector.

Installation Procedure



IMPORTANT:
When ordering new fuel injectors, be sure to order the correct injector for the application being serviced. The fuel injector (1) is stamped with a part number identification (2). A 4-digit build date code (3) indicates the month (4), day (5), year (6), and shift (7) that built the injector.

1. Lubricate the NEW injector O-ring seals (2, 4) with clean engine oil.
2. Install the NEW injector O-ring seals onto the injector.
3. Install a NEW retaining clip (1) on the injector.
4. Push the fuel injector (5) into the fuel rail with the electrical connector facing outwards. The retaining clip (4) locks onto a flange on the fuel rail injector socket.
5. Install the fuel rail. Refer to Fuel Rail Assembly Replacement .

Fuel Injector Cleaning

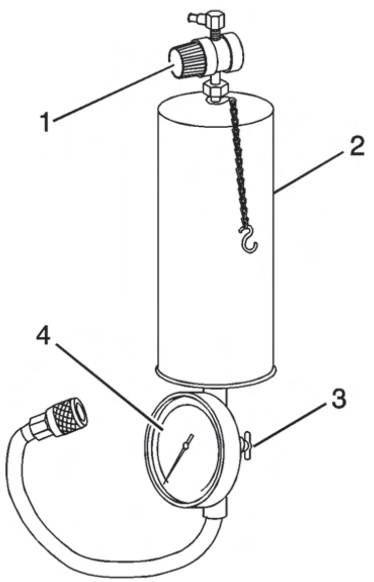
Tools Required

- J 37287 Fuel Line Shut-Off Adapters
- J 35800-A Fuel Injector Cleaner
- J 42873-1 3/8 Fuel Line Shut-Off Valve
- J 42873-2 5/16 Return Pipe Shut-Off Valve
- J 42964-1 3/8 Fuel Pipe Shut-Off Valve
- J 42964-2 5/16 Fuel Pipe Shut-Off Valve

NOTICE:
- *GM Top-Engine Cleaner is the only injector cleaning agent recommended. Do not use other cleaning agents, as they may contain methanol which can damage fuel system components.*
- *Under NO circumstances should the top engine cleaner be added to the vehicles fuel tank, as it may damage the fuel pump and other system components.*
- *Do not exceed a 10 percent cleaning solution concentration. Higher concentrations may damage fuel system components. Testing has demonstrated that exceeding the 10 percent cleaning solution concentration does not improve the effectiveness of this procedure.*

IMPORTANT:
Vehicles with less than 160 km (100 mi) on the odometer should not have the injectors cleaned. These vehicles should have the injectors replaced.

IMPORTANT:
During this procedure you will need a total of 960 ml (32.4 oz) of cleaning solution. That is 2 tanks of solution for the J 35800-A . Other brands of tools may have a different capacity and would therefore require more or less tanks to complete the procedure. You must use all 960 ml (32.4 oz) of solution to ensure complete injector cleaning.



1. Obtain J 35800-A (2).

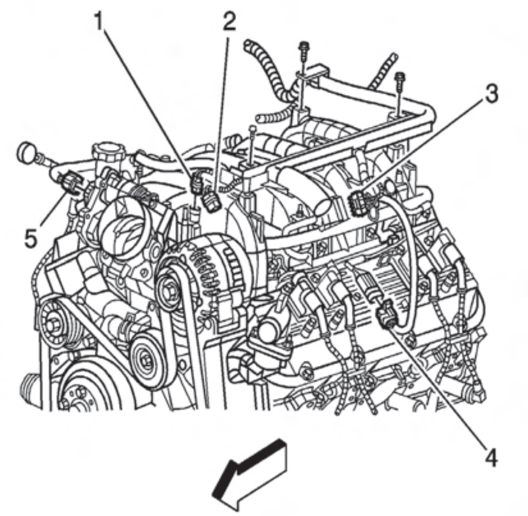
IMPORTANT:
Make sure the valve at the bottom of the canister (3) is closed.

2. For US dealers, empty 2 pre-measured GM Top-Engine Cleaner containers, 24 ml (0.812 oz) each, GM P/N 12346535, into the J 35800-A .
3. For Canadian dealers, measure and dispense 48 ml (1.62 oz) of Top-Engine Cleaner, Canadian P/N 992872, into the J 35800-A .
4. If you are using any other brand of tank you will need a total of 96 ml (3.24 oz) of Top-Engine Cleaner mixed with 864 ml (29.16 oz) of regular unleaded gasoline.
5. Fill the injector cleaning tank with regular unleaded gasoline. Be sure to follow all additional instructions provided with the tool.
6. Electrically disable the vehicle fuel pump by removing the fuel pump relay and disconnecting the oil pressure switch connector, if equipped.
7. Disconnect the fuel feed and return line, if equipped, at the fuel rail. Plug the fuel feed and return line, if equipped, coming off the fuel rail with J 37287 , or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 as appropriate for the fuel system.
8. Connect the J 35800-A to the vehicle fuel rail.
9. Pressurize the J 35800-A to 510 kPa (75 psi).
10. Start and idle the engine until it stalls due to lack of fuel. This should take approximately 15-20 minutes.
11. Disconnect J 35800-A from the fuel rail.
12. Reconnect the vehicle fuel pump relay and oil pressure switch connector, if equipped.
13. Remove J 37287 or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 and reconnect the vehicle fuel feed and return lines.
14. Start and idle the vehicle for an additional 2 minutes to ensure residual injector cleaner is flushed from the fuel rail and fuel lines.
15. Repeat steps 1-5 of the Injector Balance Test, and record the fuel pressure drop from each injector.

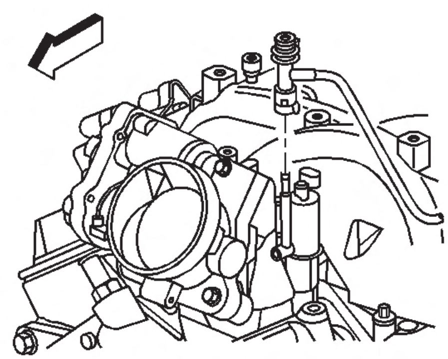
16. Subtract the lowest fuel pressure drop from the highest fuel pressure drop. If the value is 15 kPa (2 psi) or less, no additional action is required. If the value is greater than 15 kPa (2 psi), replace the injector with the lowest fuel pressure drop.
17. Add one ounce of Port Fuel Injector Cleaner, GM P/N 12345104 (Canadian P/N 10953467), to the vehicle fuel tank for each gallon of gasoline estimated to be in the fuel tank. Instruct the customer to add the reminder of the bottle of Port Fuel Injector Cleaner to the vehicle fuel tank at the next fill-up.
18. Advise the customer to change brands of fuel and to add GM Port Fuel Injector Cleaner every 5 000 km (3,000 mi). GM Port Fuel Injector Cleaner contains the same additives that the fuel companies are removing from the fuel to reduce costs. Regular use of GM Port Fuel Injector Cleaner should keep the customer from having to repeat the injector cleaning procedure.
19. Road test the vehicle to verify that the customer concern has been corrected.

Evaporative Emission Canister Purge Solenoid Valve Replacement

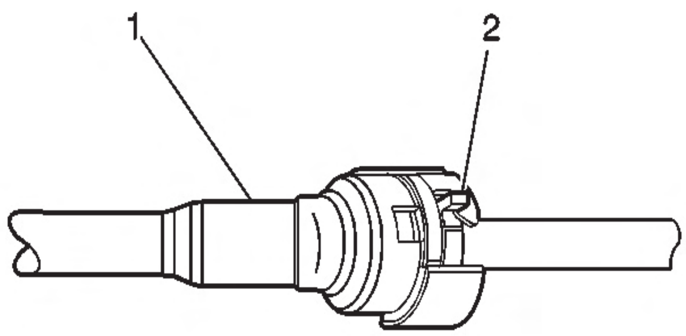
Removal Procedure



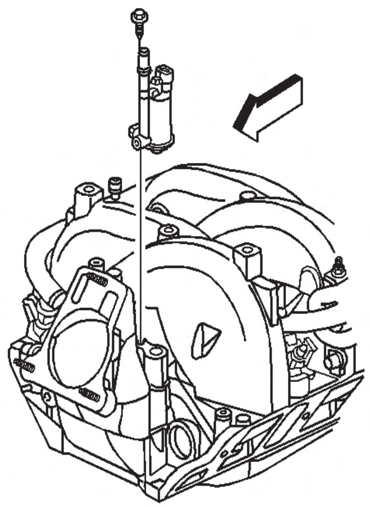
1. Disconnect the evaporative emission (EVAP) canister purge valve electrical connector (1).



2. Disconnect the EVAP purge tube from the purge solenoid.



3. In order to disconnect the EVAP purge tube connector (1), slide the retaining tab (2) to the release position and separate the connection.



5. Remove the EVAP canister purge valve bolt.
6. Remove the EVAP canister purge valve.

Installation Procedure

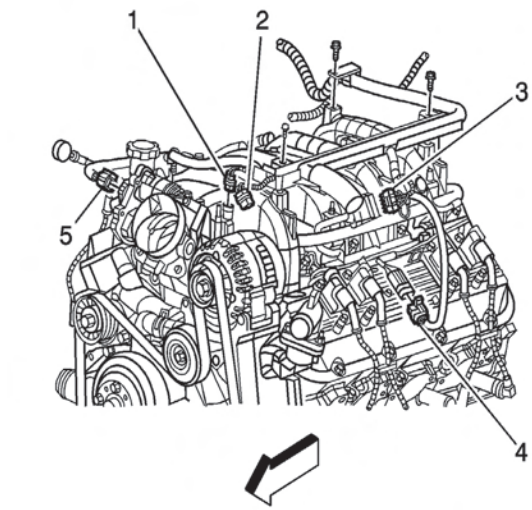
1. Install the EVAP canister purge valve.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

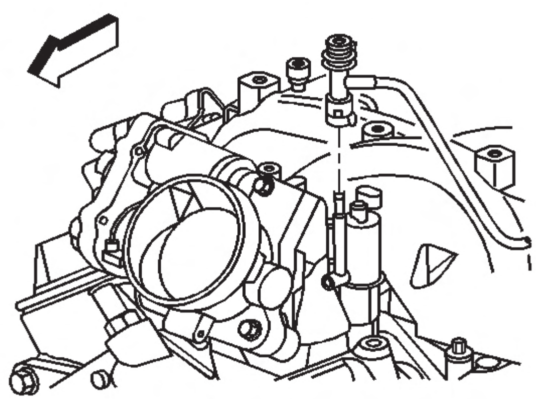
2. Install the EVAP canister purge valve bolt and tighten the bolt to 10 N·m (89 lb in).
3. Connect the EVAP purge tube to the purge solenoid.
4. Connect the EVAP canister purge valve electrical connector (1).
5. Install the engine sight shield. .

Evaporative Emission Hoses/Pipes Replacement – Engine

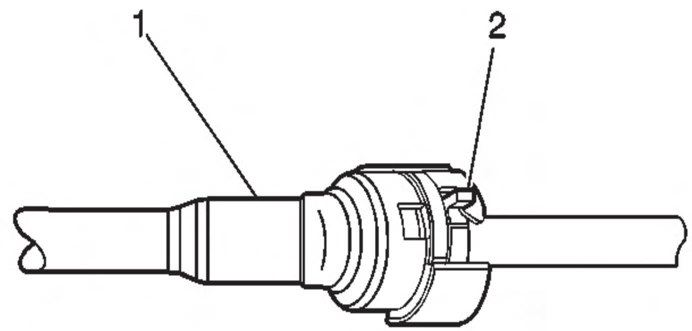
Removal Procedure



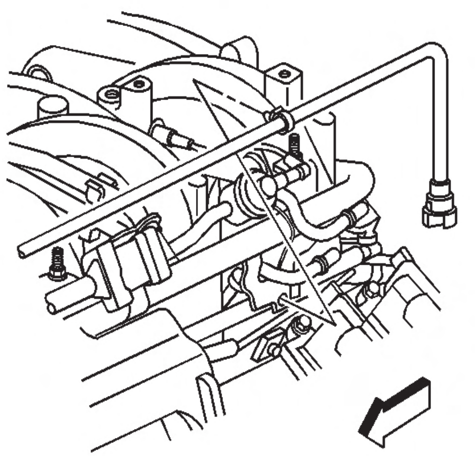
1. Remove the engine sight shield.
2. Disconnect the fuel injector harness electrical connector (3).



3. Disconnect the evaporative emission (EVAP) purge tube at the purge solenoid.



4. To disconnect the EVAP purge tube connector (1), slide the retaining tab (2) to the release position and separate the connection.



5. Disconnect the EVAP purge tube clip from the fuel rail bracket.
6. Disconnect the EVAP purge tube at the EVAP pipe.

Installation Procedure

1. Connect the EVAP purge tube at the EVAP pipe.
2. Connect the EVAP purge tube clip to the fuel rail bracket.
3. Connect the EVAP purge tube at the purge solenoid.
4. Connect the fuel injector harness electrical connector (3).
5. Install the engine sight shield.

Evaporative Emission System Cleaning

Tools Required

- J 41413-200 EVAP Pressure/Purge Diagnostic Station

Inspection Procedure

NOTICE:
Use the EVAP Pressure/Purge Diagnostic Station J 41413 in order to provide a clean, dry, low pressure gas source. Do not substitute any other pressurized gas source. Damage may result to the EVAP system.

IMPORTANT:
DO NOT perform this procedure unless instructed by an EVAP diagnostic.

1. Turn OFF the ignition.
2. Remove the EVAP canister purge valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement .
3. Lightly tap the EVAP canister purge valve on a clean hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
   - If no carbon particles are found, install the EVAP canister purge valve and continue with the EVAP cleaning procedure.
   - If carbon particles are found during the inspection procedure, continue with the EVAP cleaning procedure.
   - If you were instructed to replace the EVAP canister purge valve, and no carbon particles are found, return to the EVAP diagnostic procedure. Do not perform the EVAP cleaning procedure.

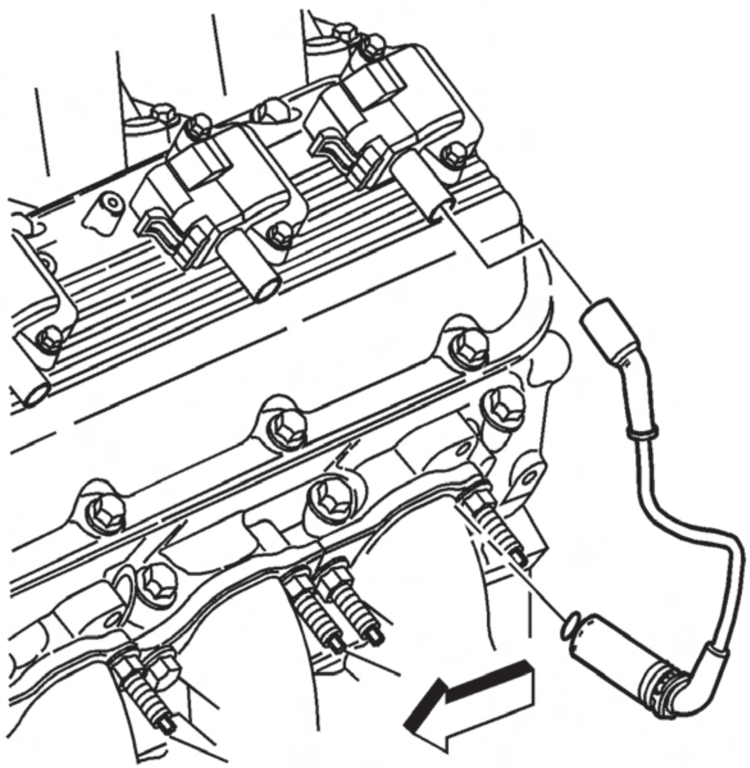
EVAP Cleaning Procedure

1. Remove the EVAP canister. Refer to Evaporative Emission Canister Replacement .
2. Turn OFF the main valve on the J 41413-200 .
3. Disconnect the hose from the diagnostic station pressure regulator.
4. Using a section of vacuum hose, connect one end to the diagnostic station pressure regulator.
5. Connect the other end of the vacuum hose to the canister side of the purge pipe.
6. Turn on the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
7. If the nitrogen does not dislodge the carbon particles, replace the purge pipe. Refer to Evaporative Emission (EVAP) Hoses/Pipes Replacement - Engine .
8. Return the J 41413-200 to its original condition.
9. Install a new EVAP canister. Refer to Evaporative Emission Canister Replacement .

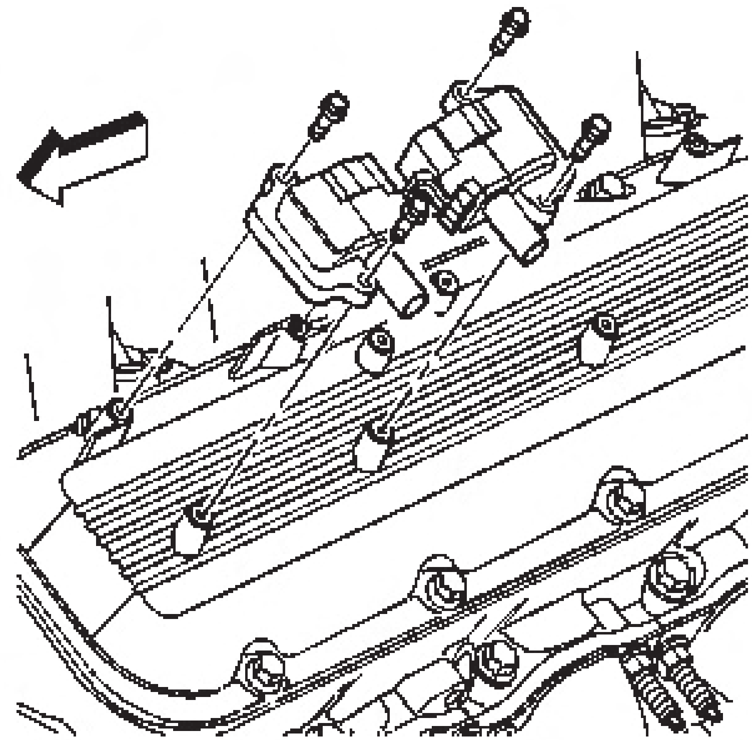
10. Install the EVAP canister purge valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement .
11. Lower the vehicle.
12. Continue with the published service manual diagnostic DTC procedure.

Ignition Coil Replacement

Removal Procedure



1. Disconnect the spark plug wire from the ignition coil.
   - Twist the spark plug boot 1/2 turn.
   - Pull only on the boot in order to remove the wire from the ignition coil.
2. Disconnect the ignition coil electrical connector.



3. Remove the ignition coil bolts.
4. Remove the ignition coil.

Installation Procedure

NOTICE:
This component is initially installed using a self-tapping bolt. Care should be taken when removing and/or installing the self-tapping bolt. Failure to use care when removing and/or installing the self-tapping bolt can lead to damage and unnecessary replacement of the self-tapping bolt and/or the component the self-tapping bolt is threaded into.

1. Install ignition coil.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

2. Install the ignition coil bolts and tighten to 12 N·m (106 lb in).
3. Connect the ignition coil electrical connector.
4. Connect the spark plug wire to the ignition coil.
5. Inspect the wire for proper installation:
   5.1. Push sideways on the boot in order to inspect the seating.
   5.2. Reinstall any loose boot.

Spark Plug Wire Inspection

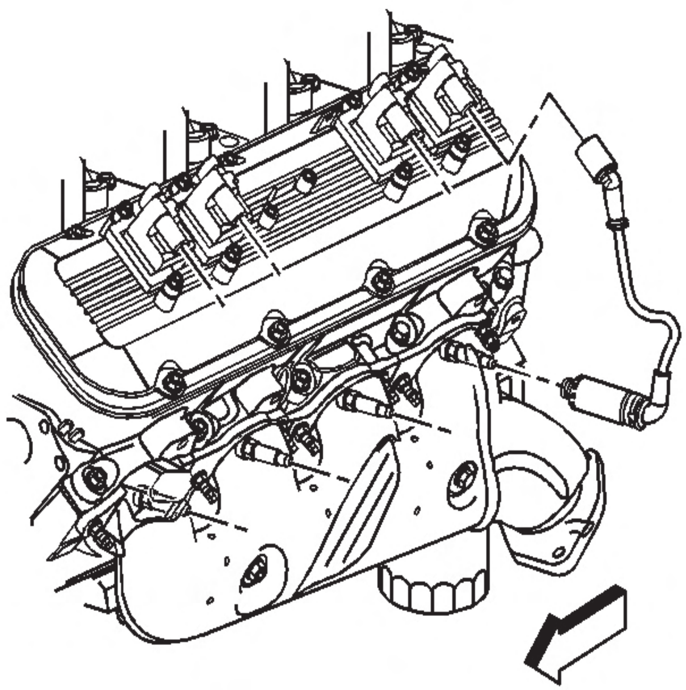
Spark plug wire integrity is vital for proper engine operation. A thorough inspection is necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Correct routing of the spark plug wires.
2. Incorrect routing may cause cross-firing. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
   – Tearing
   – Piercing
   – Arcing
   – Carbon tracking
   – Corroded terminal

If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or terminal, replace the wire and the component connected to the wire.

Spark Plug Wire Replacement

Removal Procedure

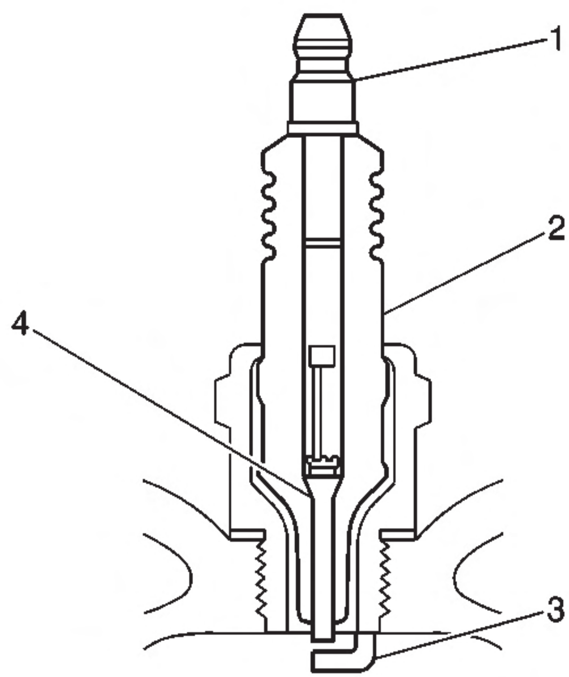


1. Disconnect the spark plug wire at the spark plug.
   – Twist the spark plug wire 1/2 turn.
   – Pull only on the boot in order to remove the wire from the spark plug.
2. Disconnect the spark plug wire from the ignition coil.
   – Twist each spark plug boot 1/2 turn.
   – Pull only on the boot in order to remove the wire from the ignition coil.

Installation Procedure

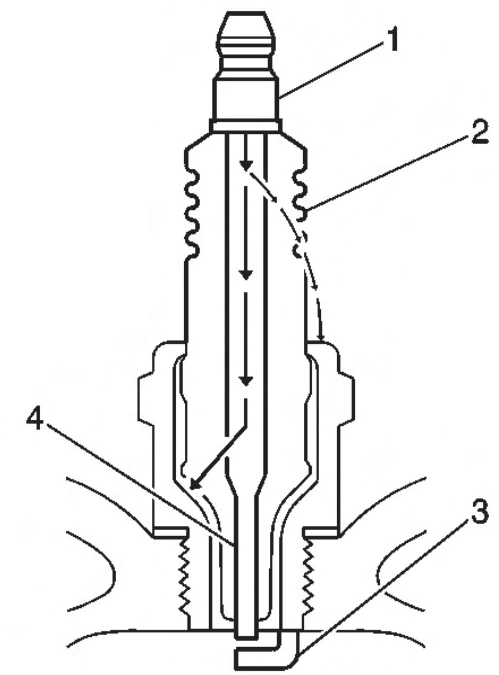
1. Install the spark plug wire at the ignition coil.
2. Install the spark plug wire to the spark plug.
3. Inspect the wire for proper installation:
   A. Push sideways on the boot in order to inspect the seating.
   B. Reinstall any loose boot.

Spark Plug Inspection

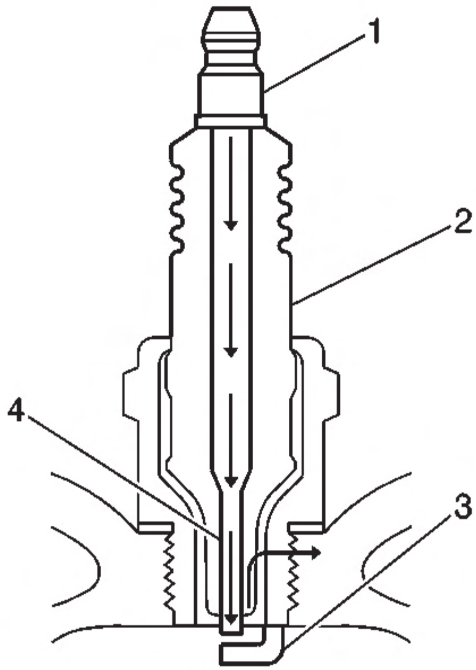


1. Verify that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to Ignition System Specifications for the correct spark plug.

- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
  - Spark plug fouling - Colder plug
  - Pre-ignition causing spark plug and/or engine damage - Hotter plug
- Inspect the terminal post (1) for damage.
  - Inspect for a bent or broken terminal post (1).
  - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.
  - Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
  - Inspect the spark plug boot for damage.
  - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.



- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).



- Inspect for evidence of improper arcing.
  - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to Ignition System Specifications . An excessively wide electrode gap can prevent correct spark plug operation.
  - Inspect for the correct spark plug torque. Refer to Ignition System Specifications . Insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
  - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
  - Inspect for a broken or worn side electrode (3).
  - Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
  - A rattling sound indicates internal damage.
  - A loose center electrode (4) reduces the spark intensity.
  - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
  - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
  - Inspect for excessive fouling.
- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

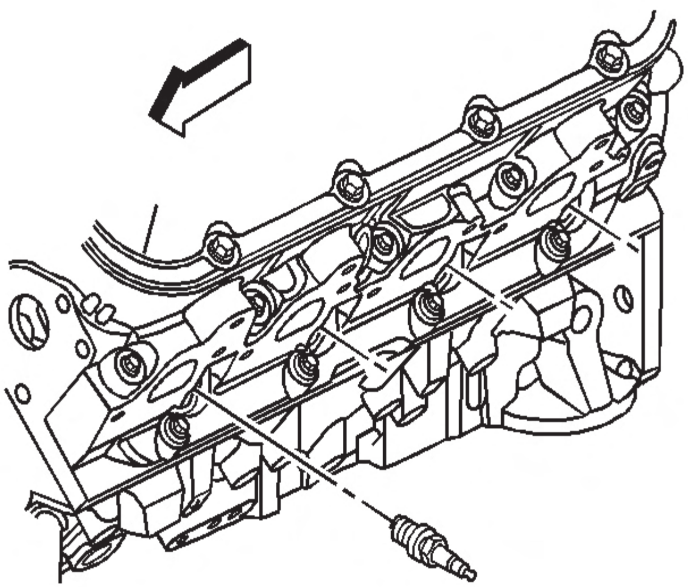
Visual Inspection

- Normal operation--Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon fouled--Dry, fluffy black carbon, or soot caused by the following conditions:
  - Rich fuel mixtures
- Leaking fuel injectors
- Excessive fuel pressure
- Restricted air filter element
- Incorrect combustion
  - Reduced ignition system voltage output
- Weak coils

- Worn ignition wires
- Incorrect spark plug gap
  - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit fouling--Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

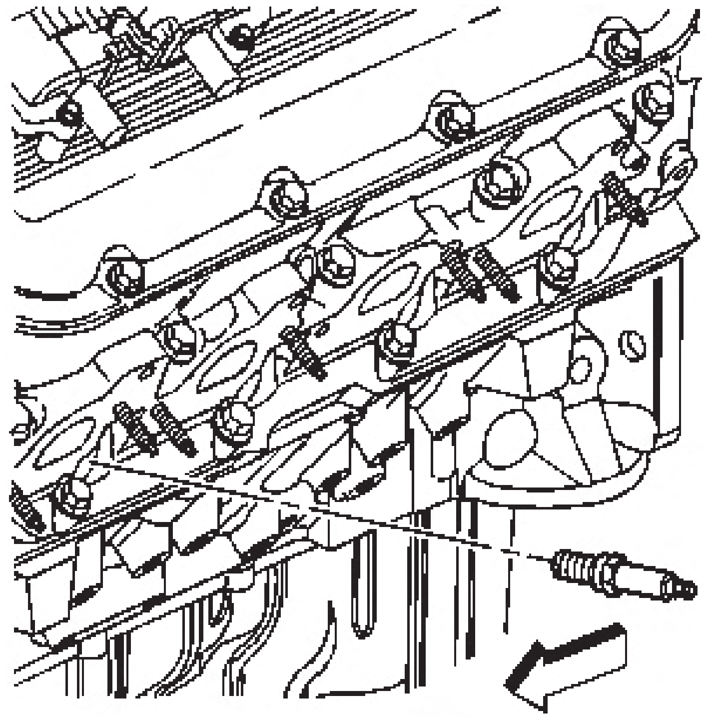
Spark Plug Replacement

Removal Procedure



1. Remove the spark plug wire. Refer to Spark Plug Wire Replacement .
2. Loosen the spark plug 1 or 2 turns.
3. Brush or using compressed air, blow away any dirt from around the spark plug.
4. Remove the spark plug. If removing more than one plug, place each plug in a tray marked with the corresponding cylinder.

Installation Procedure



1. Correctly position the spark plug washer.
2. Inspect the spark plug gap. Adjust the gap as needed.
   - Specification
     - Spark plug gap: 1.524 mm (0.060 in)
3. Hand start the spark plug in the corresponding cylinder.

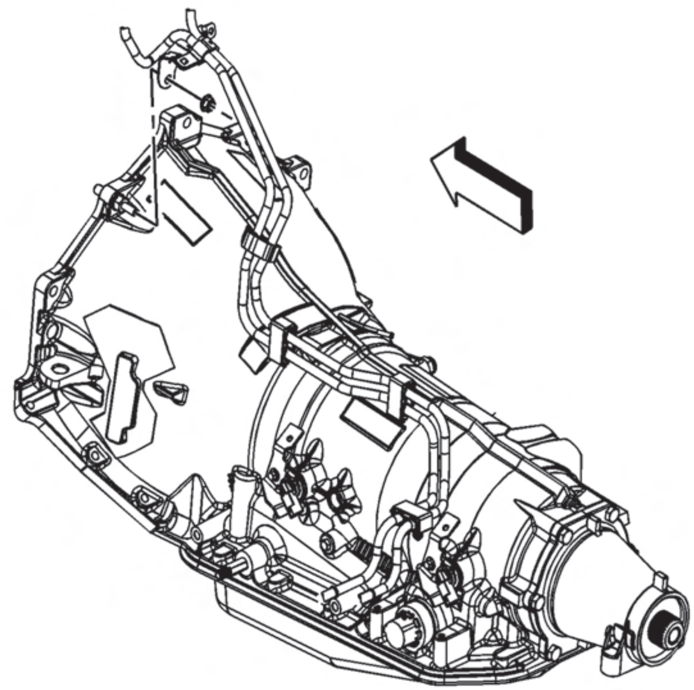
NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

4. Tighten the spark plug as follows:
   - Tighten the plug to 20 N·m (15 lb ft) for USED heads.
   - Tighten the plug to 30 N·m (22 lb ft) for NEW heads.
5. Install the spark plug wire. Refer to Spark Plug Wire Replacement .

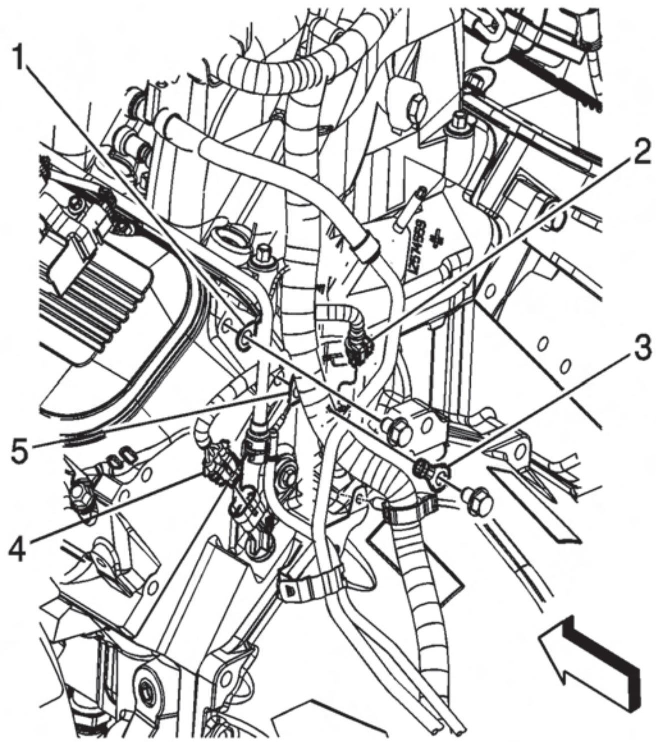
Crankshaft Position Sensor Replacement

Removal Procedure

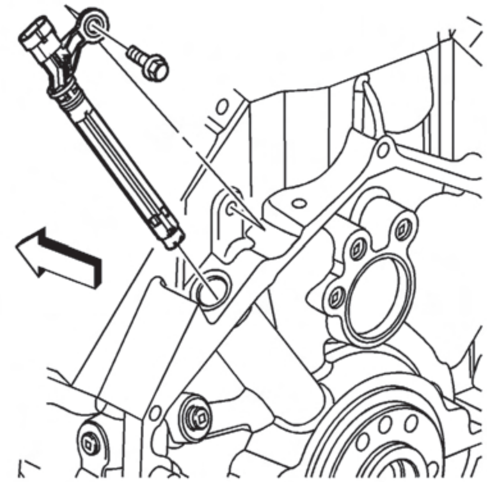
NOTICE:
In order to prevent damage to the crankshaft position (CKP) sensor reluctor wheel/ring, care must be used when removing or installing this component.



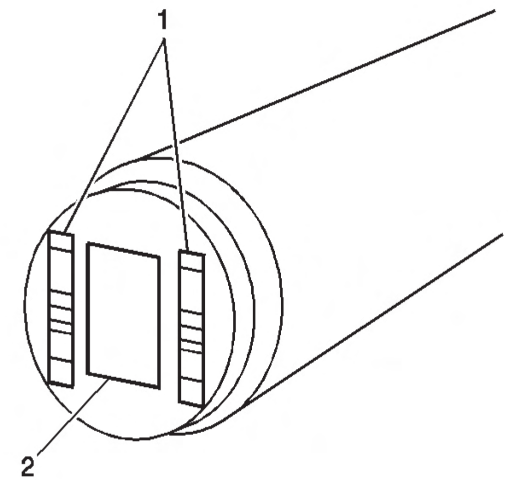
1. Raise and suitably support the vehicle.
2. Remove the fuel line bracket nut.
3. Remove the fuel line bracket from the bellhousing stud.
4. Lower the vehicle.



5. Remove the driver side rear ignition coil bolts.
6. Reposition the ignition coil.
7. Disconnect the crankshaft position (CKP) sensor electrical connector (4).
8. Use penetrating oil and allow the oil to soak around the CKP sensor prior to removing the sensor.



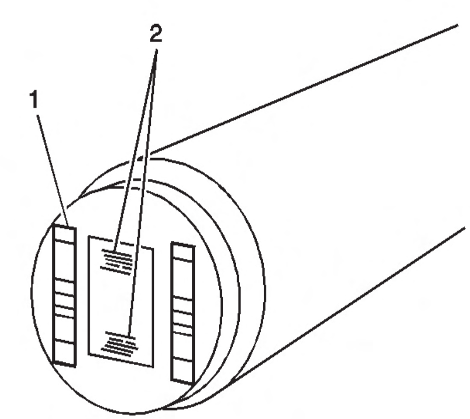
9. Remove the CKP sensor bolt.
10. Twist the CKP sensor back and forth.
11. Pull the sensor straight up in order to remove the CKP sensor.



12. Inspect the CKP sensor for wear.

IMPORTANT:
The CKP sensor is designed to contact the reluctor wheel of the crankshaft. Wear may be noticeable on the end of the sensor.

13. Normal CKP sensor wear will be shown on the wear strips (1) and no wear will be shown on the sensor sensing element (2).



14. Excessive or abnormal sensor wear will be shown on the sensing element (2).
15. If excessive/abnormal wear is present, replace the sensor.

Installation Procedure

1. If reusing the old sensor, inspect both O-rings for cuts, cracks, tears or damage, replace the O-rings as needed.
2. Lubricate the CKP sensor O-rings with clean engine oil.

IMPORTANT:
Ensure that the CKP sensor is fully seated against the crankshaft reluctor ring. The upper flange on the sensor MAY NOT seat against the engine block.

3. Install the CKP sensor.

IMPORTANT:
The CKP sensor bolt has adhesive applied to the threads. The adhesive may have come off during removal of the bolt. Ensure that the bolt hole is clean of any debris before installing the reinstalling bolt.

4. If reusing the old sensor, apply thread adhesive GM P/N 12345493 (Canadian P/N 10953488) or equivalent to the threads.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

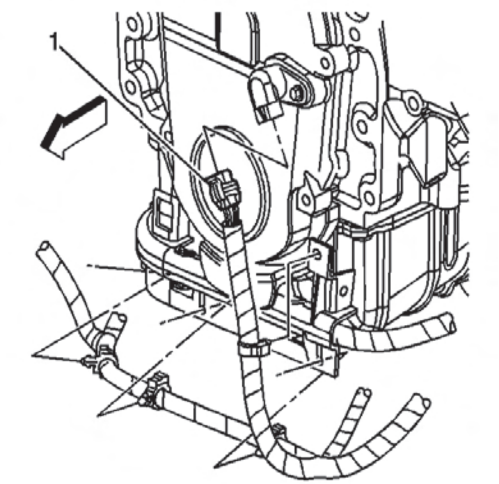
5. Install the CKP sensor bolt tighten to 12 N·m (106 lb in).
6. Connect the CKP sensor electrical connector (4).
7. Position the ignition coil to the rocker cover.
8. Install the driver side rear ignition coil bolts and tighten the bolts to 12 N·m (106 lb in).
9. Raise the vehicle
10. Install the fuel line bracket to the bellhousing stud.

11. Install the fuel line bracket nut and tighten to 10 N·m (89 lb in).
12. Lower the vehicle.
13. Perform the CKP system variation learn procedure. Refer to Crankshaft Position System Variation Learn .

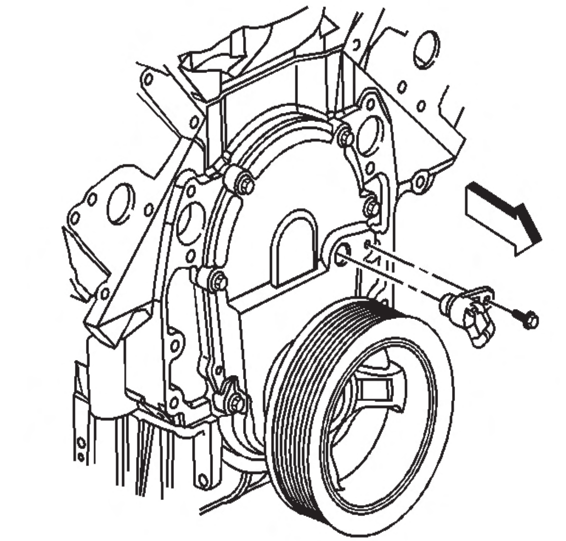
Camshaft Position Sensor Replacement

Removal Procedure

1. Raise and suitably support the vehicle.
2. Remove the engine shield bolts and shield, if equipped.



3. Disconnect the camshaft position (CMP) sensor electrical connector (1).



4. Remove the CMP sensor bolt.
5. Remove the CMP sensor.
6. Inspect the CMP sensor for wear, cracks or leakage if the sensor is not being replaced.

Installation Procedure

IMPORTANT:
Inspect the CMP sensor O-ring for wear or damage. If a problem is found, replace the O-ring. Lubricate the new O-ring with engine oil before installing.

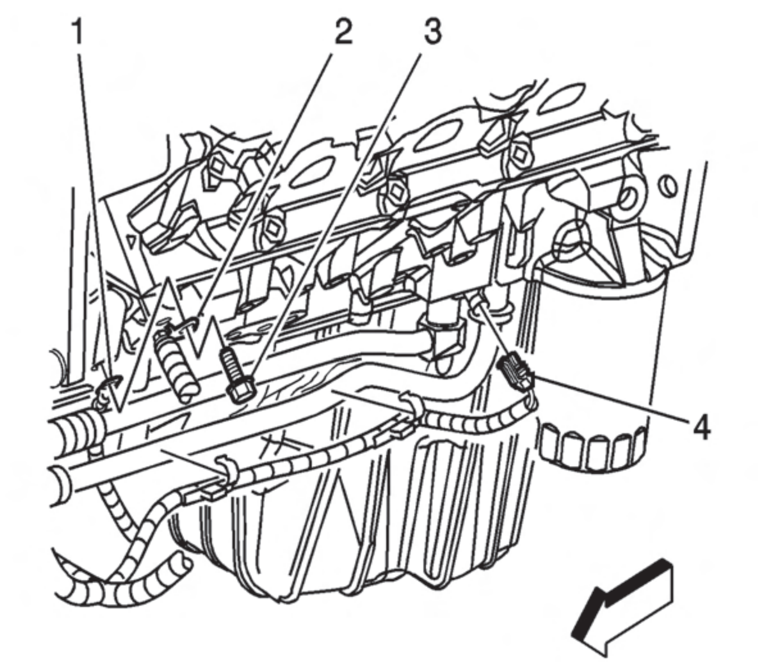
1. Install the CMP sensor.

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

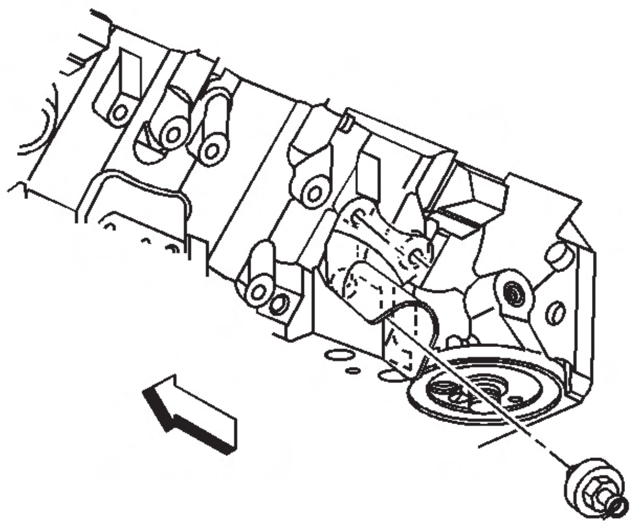
2. Install the CMP sensor bolt and tighten to 12 N·m (106 lb in).
3. Connect the CMP sensor electrical connector (1).
4. Install the engine shield and bolts, if equipped, and tighten the bolt to 20 N·m (15 lb ft).
5. Lower the vehicle.

Knock Sensor 1 Replacement

Removal Procedure



1. Drain the cooling system/engine block.
2. Disconnect the knock sensor electrical connector (4).



3. Remove the knock sensor.

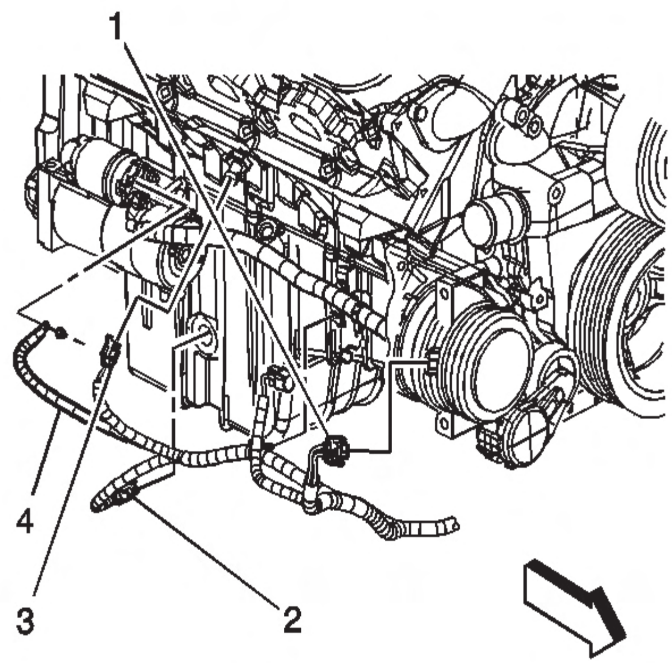
Installation Procedure

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

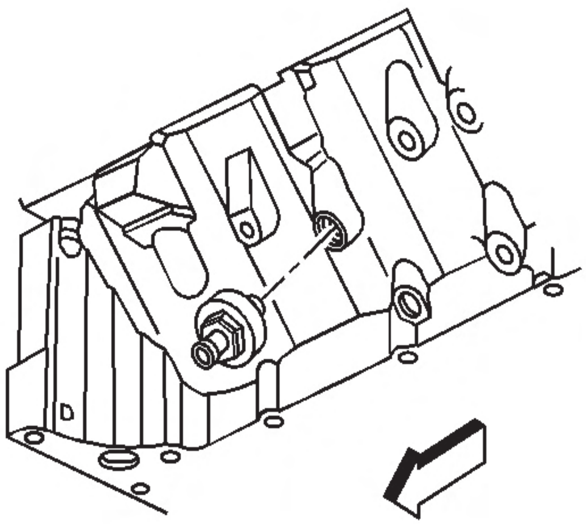
1. Install the knock sensor tighten to 20 N·m (15 lb ft).
2. Connect the knock sensor electrical connector (4).
3. Fill the cooling system/engine block.

Knock Sensor 2 Replacement

Removal Procedure



1. Drain the cooling system/engine block.
2. Disconnect the knock sensor electrical connector (3).



3. Remove the knock sensor.

Installation Procedure

NOTICE:
Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

1. Install the knock sensor and tighten the sensor to 20 N·m (15 lb ft).
2. Connect the knock sensor electrical connector (3).
3. Fill the cooling system/engine block.