GCP / 4G
Diagnostic
Service
Manual
Serial Number 470000 through Present
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Abbreviations

AL Adaptive Learn
BP Barometric Pressure
CAN Controller Area Network
CL Closed Loop
DBW Drive-By-Wire
DMM Digital Multi-Meter (high impedance)
DST Diagnostic Scan Tool
DTC Diagnostic Trouble Code
DVOM Digital Voltage and Ohm Meter (high impedance)
ECM Engine Control Module
ECT Engine Coolant Temperature
EGO Exhaust Gas Oxygen Sensor, typically heated
EMWT Exhaust Manifold Water Temperature
ETC Electronic Throttle Control
FMI Failure Mode Indicator
FO Firing Order
FP Fuel Pressure
FPP Foot Pedal Position
HEGO Heated Exhaust Gas Oxygen Sensor (same as HO2S)
HO2S Heated Oxygen Sensor (same as HEGO)
IAT Intake Air Temperature
IVS Idle Validation Switch
LED Light Emitting Diode
MAP Manifold Absolute Pressure
MIL Malfunction Indicator Lamp
OBD On-Board Diagnostics
OEM Original Equipment Manufacture
PC Personal Computer
PFI Port Fuel Injection
PGN Parameter Group Number
PWM Pulse Width Modulated
RAM Random Access Memory
RPM Revolutions Per Minute
SPN Suspect Parameter Number
Tach Tachometer
TCP Throttle Control Position
TDC Top Dead Center
TPS Throttle Position Sensor
VDC Voltage, Direct Current
Vsw Switched, Ignition Voltage
OVERVIEW

This manual is intended to be used as an aid for customers troubleshooting ECM-07/08 drivability problems. This manual defines the diagnostics and recommended troubleshooting procedures associated with an ECM-07/08 controlled engine. Troubleshooting trees are provided to aid in this process. Three types of trees are used throughout this manual.

The Basic Troubleshooting Tree used provides test and instruction for a trouble condition. It is most often accompanied by an explanation of the tests and decision branches.

The second diagnostic tree will provide you with the test and instructions for the suspect circuit.
This diagnostic manual will assist you in troubleshooting an ECM-07/08 Engine Management System. Always begin troubleshooting with the Drivability Checklist section of this manual then refer to the appropriate section to continue diagnosis and repair.

- the Drivability Checklist,
- the Main Engine Electrical System Components,
- the Engine Fuel System Components,
- the Engine Cooling System Components, and
- the ECM-07/08 Engine Management System,
- the Engine Mechanical Components (refer to the appropriate Engine Mechanical Manual - L510003-8.1L; L510015-5.7L; L510016-6.0L).

DIAGNOSTIC TOOLS

There are many different tools used to effect a repair on an engine. When troubleshooting an ECM-07/08 engine, there are three (3) required tools that are essential in the diagnosis and maintenance of these engines. Procedures and diagnostics that follow, assume these tools are available and used by the service technician.

These required tools are not unique to ECM-07/08 engines and are used for troubleshooting fuel injected engines with a wide variety of engine control systems.

The required tools are:

- Fuel Pressure Guage
- Digital Multimeter (also known as a Digital Volt/Ohm Meter)

The fuel pressure gauge (PCM P/N - RTK0078) is essential for reading the fuel pressure under all operating conditions when diagnosing a fuel injected engine.

The Digital Multi-Meter (DMM or DVOM - Digital Volt/Ohm Meter), with a minimum input impedance of 10 mega-ohms (Mohms) is essential to take various measurements on the engine’s electrical system.
DIAGNOSTIC AIDS

There are various and many different tools that you will find essential for troubleshooting, from time to time. Pictured below are some of the common items used. They include, but are not limited to, an inductive pickup timing light, test lamp, connector tools, injector test lamps, and various adapters and connector test harnesses.

Diacom Diagnostic Software, Marine Edition, by Rinda Technologies, Inc. (PCM P/N - RT0086); and the Diacom CAN Network Adapter (PCM P/N - RT0088). This is a PC based software package that supports various ECMs used on fuel injected engines.

In the past, as new ECM’s were introduced into the marine industry, Diacom evolved with each new generation. As the power of the ECMs has improved, new test capabilities became available through the Diacom Tests screens, making Diacom an increasingly useful and powerful tool for troubleshooting.

ECM-07/08 is no different than any previous generation of engine controller. Not only has it provided improved engine control, it has increased diagnostic capability. When Diacom is connected, there are new features and tests available that have not been available with past generations of controllers.

One of the more common circuit test tool used is the un-powered test lamp. While this is an extremely useful tool, you must ensure that the one you use is safe to use on ECM-07/08 circuits. When a test light is specified, a “low-power” test light must be used. Do not use a high-wattage test light. While a particular brand of test light is not suggested, a simple test on any test light will ensure it to be safe for system circuit testing (refer to the test diagram that follows). Connect an accurate ammeter (such as the high-impedance digital multimeter) in series with the test light being tested, and power the test light ammeter circuit with the vehicle battery.
Two of the more widely used diagnostic aids are the Remote Key Switch (RT0091) and an Auxiliary Fuel Tank equipped with both a fuel supply and fuel return line.

The Remote Key Switch (RT0091, for ECM-07/08 equipped engines), pictured above, is extremely useful for isolating the boat wiring from the engine wiring when trying to isolate electrical problems.

An Auxiliary Fuel Tank (dealer fabricated) is absolutely essential for troubleshooting drivability problems that may be fuel related. Ensure that your fuel tank is equipped with a fuel return line. The ability to completely isolate the boat fuel system from the engine, using a known good fuel source, is essential for troubleshooting fuel system problems or perceived fuel system problems.

If the ammeter indicates **less** than 3/10 amp (.3A) current flow, the testlight is **safe** to use.
If the ammeter indicates **more** than 3/10 amp (.3A) current flow, the testlight is **not safe** to use.
INTRODUCTION
Since the conception of the internal combustion engine there have been three absolutes that are required to make an engine run:

• FUEL
• SPARK, and
• AIR.

While there have been significant advances in the engine management systems, those three absolutes remain, fuel, spark, and air are required to make the engine run. Simply, successful troubleshooting of a drivability problem is accomplished by isolating the problem to one of these three areas, then repair the source of the problem.

With each generation of improvement in the engine management system, troubleshooting, maintaining, tune ups, and repair have become much easier to accomplish.

BASIC TROUBLESHOOTING APPROACH
Start by taking a ‘systems’ approach to the engine. Proper engine operation depends on numerous systems and components functioning together. This of course, makes any one system dependant upon the proper operation of all the other systems. The common thread through all the systems is the Main Electrical System. If you do not have the proper system voltage and ground, none of the other engine systems can function properly.

When troubleshooting an ECM-07/08 Engine Management System it is necessary that:

- the Main Engine Electrical System Components,
- the Engine Fuel System Components,
- the Engine Cooling System Components, and
- the Engine Mechanical Components,

are all functioning as designed prior to troubleshooting the ECM-07/08 System. The Drivability Checklist is designed to help you insure that requirement is met.

Refer to Figure 2-1 and 2-2 for the relationship between the Basic Troubleshooting Approach and the Drivability Checklist. Successful problem diagnosis requires the following approach be applied to all reported problems. There are seven basic steps to troubleshooting a problem, and these steps are the basis for the Drivability Checklist.

1. Obtain a clear, concise description of the problem.
2. Check for Service Bulletins.
3. Perform a detailed visual inspection.
4. Verify the problem.
5. Perform the ECM-07/08 System Check
6. Isolate and Repair the problem
7. Clear the ECM of Codes and Verify the problem has been corrected.

Using the Drivability Checklist will help you stay focused on the task at hand. Do all the steps, and in the order provided for every drivability problem encountered.

Most ECM-07/08 circuit failures cause stored codes which have a diagnostic and repair procedure designed to resolve the problem causing the code.

Analyzing and resolving ECM-07/08 and non-ECM-07/08 problems are made easier using the Drivability Checklist. Especially when a code is cleared, does not reoccur but, a problem is still present.

Problems which do not set codes must be resolved using the symptom present. Some symptoms are easily recognized — “the engine overheated”; other symptoms can be vague, one person’s description of hesitation may be another person’s stumble. In these cases, you are dealing with conditions where the engine/boat package is no longer performing as it once did. Using the Drivability Checklist will help resolve these problems more readily.

THE DRIVABILITY CHECKLIST
The seven checks of the Basic Troubleshooting Tree are the basis for the Drivability Checklist, Figure 2-3. These seven steps can be applied to every problem that you encounter. Let’s take a closer look at the seven steps of the Drivability Checklist.

NOTE: For illustrative purposes each step presumes the problem has not been resolved. Therefore, you proceed to the next step. In actual troubleshooting if any step corrects the problem there would be no reason to proceed further, you would verify your repair, Step 7 of the Drivability Checklist, and return the boat to its owner.

1. Obtain a clear, concise description of the problem.
   Whenever possible, interrogate the owner/operator and find out the conditions leading up to, and under which the problem occurred. Information related to recent service on the engine or recent unexpected or abnormal events can greatly aid you in your troubleshooting effort.

   Often, an owner/operator provides only information about the symptom that is currently present. Find out if any recent work was performed on the engine, such as a broken belt or failed raw water pump impeller.

   Has someone already tried to correct the current problem?
   Have any new accessories been added recently?
   Did the problem occur shortly after the last time he refueled?
   Did the problem occur after a recent repair such as a hull repair where the underwater gear was replaced?

   As you can see, there are numerous questions that could be asked based on the symptom and the owner/operator’s responses. Some of the more important questions to ask
BASIC TROUBLESHOOTING APPROACH

1. Obtain a clear concise description of the problem
2. Check for applicable Service Bulletins
3. Perform a visual inspection of the engine for obvious faults
4. Verify the Problem ‘Taking the Engine’s Pulse’
5. Perform the ECM-07/08 System Check
6. Isolate and Repair the Problem
7. Check/Clear Trouble Codes from ECM
   Verify the Problem has been Corrected

Figure 2-1 Basic Troubleshooting Approach Tree
**DRIVABILITY CHECKLIST TROUBLESHOOTING TREE**

**STEP 1**
Obtain a clear concise description of the problem

**STEP 2**
Check for applicable Service Bulletins

**STEP 3**
Perform a visual inspection of the engine for obvious faults

**STEP 4**
Verify the Problem - First Look - ‘Taking the Engine’s Pulse’

**STEP 5**
Perform the ECM-07/08 System Check Troubleshooting Tree

**STEP 6**
Isolate and Repair the Problem

**STEP 7**
Check/Clear Trouble Codes from ECM. Verify the Problem has been Corrected

**STEP 6A**
Perform Drivability Checklist - Step 6A - Troubleshooting Tree.

**STEP 8**
Perform Service Bulletin Action

**STEP 9**
Corrective action performed based on obvious faults found.

**STEP 10**
Perform ‘Verify the Problem’ Troubleshooting Tree

**STEP 11**
Perform Drivability Checklist - Step 6A - Troubleshooting Tree.

**STEP 12**
Call PCM Warranty Services 803-345-0050 ext. 107

**RETURN TO THE OWNER**
are detailed on the Drivability Checklist, Figure 2-3, Step 1.

Based on the symptom you receive from the owner/operator you may already know where to begin your troubleshooting. Many symptoms provide you that quick and easy insight to the problem. Some examples would be:

- Over or Under Temperature problems – troubleshoot the Cooling System.
- Various electrical issues such as no or slow cranking, dead battery, low or high voltage reading at the dash, etc. – troubleshoot the Main Electrical System.
- Malfunction Indicator Lamp or *Check Engine Lamp is lit on the dash – troubleshoot the ECM-07/08 system.

**NOTE:** The Malfunction Indicator Lamp or Check Engine Lamp normally lights when the ECM stores a code. Some boat manufacturers utilize a Check Engine Lamp to indicate faults other than stored codes. Check your boat owners manual for each application.

Remember to closely follow the Drivability Checklist so a problem or cause of a problem is not overlooked. You may have an idea which system has failed or where the problem may be from the owner/operator’s description, but the cause of the problem may be overlooked by skipping steps. The cause of an over heat, dead battery, or no start condition, for example, may be addressed by a Service Bulletin or corrected during a thorough Visual Inspection.

Based on the symptom you receive from the owner/operator you may already know where to begin your troubleshooting. Many symptoms provide you that quick and easy insight to the problem. Some examples would be:

1. **Check for applicable Service Bulletins.** Before you begin work on an engine, always check for Service Bulletins that may apply to the engine being serviced. Service Bulletins should be performed prior to proceeding with any troubleshooting procedure.

   Record your engine serial and model numbers and engine hours on the Drivability Checklist, Figure 2-3, Step 2. This information is necessary to locate applicable Service Bulletins. With very little time and effort the reported symptom may be identified as exactly what a Service Bulletin corrects. Always check for Service Bulletins before proceeding with any other procedure.

2. **Perform a Visual Inspection of the engine for obvious faults.** One of the most important, yet least performed functions when troubleshooting is a detailed visual inspection. Always, visually and physically inspect the engine hose connections - coolant, vacuum, exhaust, and fuel, and the wiring harness and connections for any that may be loose, broken, or corroded.

   Pay close attention to the power and ground connections for corrosion and/or accessory devices added in. Improperly added accessories can adversely affect engine operation. Inspect the engine and its assemblies for signs of damage or failure. Visually inspect for signs of arcing, fluid leaks, excessive water in the bilge, cracked or damaged assemblies, and signs of excessive heat such as melted or deformed parts and discolored paint.

   Typically when you perform a visual inspection you are looking for obvious conditions that could cause the reported symptom. If an over heat is reported you look for discolored paint and other heat related damage. When you have a performance issue reported; include the often overlooked inspections of the boat, for conditions that may affect performance such as hull damage or growth, damaged underwater gear, and if the correct propeller is installed.

   Referring to the Drivability Checklist, Figure 2-3, Step 3. There are a number of inspections listed, such as damage from excessive heat, fluid leaks, fluid levels, etc. Most of the inspections listed are items easily seen as faults. When you have performance issues, such as a loss of power, RPM, or starting problems, be sure to include in your inspection a check of the ignition wires and spark plugs to include:

   - Proper routing of the plug wires,
   - Correct firing order,
   - Removal of each spark plug to include cylinder inspection for fluids, and
   - Inspection of spark plugs for fouling, gap, broken or cracked insulators and the correct type, size, reach, and heat range for the engine.

   Be alert as you perform the visual inspection, you may repair the reported problem by reconnecting a wiring connector or cleaning the corrosion away from a power or ground terminal of the battery.

   Samples of some observations that would need immediate attention before attempting to run the engine are:

   - **Slow Cranking, Hard to Start, or No Crank** – Be sure to do your visual inspection of the spark plugs and cylinders for evidence of fluids. This condition may have been caused by a Fuel System failure, Cooling System failure, water ingestion, Engine Mechanical System failure, or a Main Electrical System failure. If fluids are present, Do Not attempt to start or run the engine until the cause of the condition is corrected. Serious engine damage may occur.

   - **Melted, skinned, or burnt wiring** – You will need to repair the wiring. The condition of the wiring may have been caused by a Cooling System failure or a Main Electrical System failure.

   - **Oil level excessively high on the dipstick** – This may indicate a foreign liquid in the oil or an over-fill condition exists. Investigate and correct a high oil level condition before proceeding.

   Symptoms of too much oil in the crankcase include:
a loss of power, 
a loss of top end rpm, or
a possible low oil pressure reading.

o Evidence of excessive water in the bilge – A rust/water line on the starter/engine block is usually a good indication; if the water is not still covering these items. Multiple electrical issues may remain. Most common is a failed starter, but high water may short out the battery and other electrical devices. It may have been ingested into the engine causing a mechanical failure. And as mentioned above, you may have water in the engine oil or transmission.

The result of a good visual inspection will help you determine where you will concentrate your troubleshooting efforts.

4. Verify the problem - ‘Taking the Engine’s Pulse’. Just as a doctor would take your temperature and blood pressure on a visit, you must have your tools available when you are diagnosing a ‘sick’ engine. To verify the problem, you will connect your Diacom scan tool and Fuel Pressure gauge to the engine to begin your test to verify the problem. You should also have your Digital Multi-Meter (DMM) available.

Always verify, for yourself, that the problem you are about to troubleshoot is the same problem reported to you in Step 1 of the Drivability Checklist. Verifying the problem may require you to water test the boat, and then try to recreate the conditions under which the failure occurred.

Refer to Figure 2-3, Step 4. Step 4 of the Drivability Checklist is comprised of a series of checks leading up to verifying the reported problem.

Figure 2-4 is a trouble tree for Step 4 of Drivability Checklist. This step tests multiple systems therefore, a trouble tree is provide so you can ‘branch’ to the appropriate system when an action expected does not occur. This step will be discussed in more detail following this overall checklist discussion.

5. Perform the ECM-07/08 System Check. The ECM-07/08 System Check is an organized approach to identifying a problem created by an electronic engine control system malfunction. This check verifies the following:

- The ECM power and ground circuits.
- The ECM can communicate with the scan tool.
- The ECM will allow the engine to start and continue to run.
- The ECM has or has not stored Diagnostic Trouble Codes (DTC).

If DTC’s are present, the ECM-07/08 System Check will direct you to the next procedure you need to perform.

Details of the ECM-07/08 System Check will be covered in the ECM-07/08 diagnostic section.

6. Isolate and Repair the Problem. Sometimes easier said than done. Utilize your resources. Obtain the service manual for the problem you have encountered. Follow the procedures exactly as they are written. Do Not skip any steps. If you have reached a point in your testing where you have:

- Checked all the components in a system,
- Properly completed the Drivability Checklist procedures through Step 5,
- Completed Step 5, and did not find codes or found and corrected code related problems but, the symptom is still present or the code returned,
- An engine that starts and runs but still exhibits a symptom, and
- Any unresolved problem.

You need to STOP and refer to Figure 2-2, the Drivability Checklist, Step 6A. Step 6A is designed to check for a variety of problems known to affect drivability.

Refer to Figure 2-6, this is a Troubleshooting Tree for Step 6A of the Drivability Checklist. This trouble tree follows the items listed under Step 6A on the Drivability Checklist.

7. Verify your repair action has corrected the problem. Once you have completed a repair action, clear any codes from the ECM. If codes return after repairs are made or you had multiple codes listed in the ECM’s memory return to Step 6, Isolate and Repair the Problem, and perform the procedure and repair action for the remaining code(s). Steps 6 and 7 will have to be performed for each stored code until the system is repaired and tests normally. Always retest to verify the engine is operating normally.

The original problem may have been caused by another system or event; ensure that you have corrected both the cause and the original problem. When you verify your repair action, be sure to test With the boat in the water, and:

1) Run the boat a minimum of two (2) minutes to verify that no codes reset, and then
2) Run the boat long enough to verify your repair has corrected the problem.
DRIVABILITY CHECKLIST

ENGINE SERIAL NUMBER: 

Date: ______________ Dealership Name: _______________________________

Technician’s Name: ________________________ Technician’s Contact Phone #: __________________

Owner/Operator Name: __________________________

Person Reporting the problem (if different from owner/operator): ________________________________

Service Writer or Person that took the problem report: ________________________________

1) PROBLEM OR SYMPTOM: ____________________________________________________________

Who first observed the symptom? ___________ When did the symptom first occur? ___________

Any recent change or service work prior to symptom occurring - replaced belts or impeller, major engine or boat repairs, recently refueled, etc.? ___________ Has someone, other than yourself, tried to correct the current symptom? ___________ If yes, what work was done? ____________________________

Accessories Added Recently? ___________ Is the symptom currently present? ___________

Special conditions (if any) required to duplicate the symptom: ______________________________

Use an additional sheet of paper if more space is required for symptoms or descriptions.

2) CHECK FOR SERVICE UPDATES:

ENGINE SERIAL NUMBER: ___________ ENGINE MODEL NUMBER: ___________ ENGINE HOURS: ___

HULL NUMBER: ______________________

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>None Apply: ___ Performed: __________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOAT</td>
<td>None Apply: ___ Performed: __________________________</td>
</tr>
</tbody>
</table>

3) VISUAL INSPECTION:

<table>
<thead>
<tr>
<th>Inspection</th>
<th>YES</th>
<th>NO</th>
<th>Inspection</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of an over-heat:</td>
<td></td>
<td></td>
<td>Evidence of or Excessive Water in the Bilge:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Harness connectors connected properly:</td>
<td></td>
<td></td>
<td>Fluid levels checked:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Damage - wiring, connectors, assemblies, and Remove Spark Plugs and inspect for fluids.</td>
<td></td>
<td></td>
<td>Leaking Fluids:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion:</td>
<td></td>
<td></td>
<td>Firing order correct:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hull-clean and free of excessive growth:</td>
<td></td>
<td></td>
<td>Correct size propellers installed:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4) VERIFY THE PROBLEM - ‘TAKING THE ENGINE’S PULSE’

<table>
<thead>
<tr>
<th>Does the engine start and continue to run?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Fuel Pumps run 2-4 seconds:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Pressure near WOT specification - when pumps run:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Key-ON-Engine-OFF (KOEO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine cranks:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Pressure near WOT specification - engine cranking:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Starts and continues to run:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Key-ON-Engine-Running (KOER)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify reported symptom:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Pressure - idle:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Pressure - under load, @ WOT:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4A) Revised or additional symptom found?: ____________________________

Check Accessories Added:
- [ ] Heater
- [ ] Shower
- [ ] Hot Water Tank
- [ ] Flush Kit
- [ ] Multi-Function Display
- [ ] Synchronizer
- [ ] After-Market Stereo Equipment
- [ ] After-Market Depth/Fish Finder
- [ ] After-Market Navigational Equipment, such as GPS, Radar, Sonar, Auto-pilot systems
- [ ] After-Market Radio Equipment
- [ ] Lights
- [ ] Other - (please list)
DRIVABILITY CHECKLIST

5) PERFORM THE ECM-07/08 SYSTEM CHECK
CODE(S) PRESENT: _____________ DIAGNOSTIC PROCEDURE USED: ______________ Continue to Step 6

6) ISOLATE AND REPAIR THE PROBLEM.
Were you able to isolate and repair the problem? If YES, continue to Step 7.
If NO, complete the Drivability Checklist for No Codes, step 6A below. If the problem is still not resolved, then call for factory technical assistance.

6A) NO CODES - ENGINE RUNS - DRIVABILITY SYMPTOM STILL PRESENT

<table>
<thead>
<tr>
<th>Inspection or Check</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>9) Verify CAM Retard** (5.0/5.7L only):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10) Performance verified against a similar boat w/same engine. package, if available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11) Perform the Diacom Power Balance Check; under load, @ 1600-1800rpm:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12) Perform the harness ‘Wiggle Test’:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13) Diacom recording-Pre-Delivery test:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7) VERIFY REPAIR HAS CORRECTED THE PROBLEM. Check for and clear all codes from the ECM memory.
Water test the boat. Run the engine for a minimum of two (2) minutes, then verify that no codes have returned. Continue with your water test long enough to verify that the problem has been corrected.

** CAM Retard - ‘02 thru ‘06 = 43-47 degrees
‘07 - newer = 15 ± 2 degrees

REFERENCES:
Master Engine Specification Sheet
ECM-07/08 Diagnostic Manual
L510005P - MEFI 4/4B Diagnostic Manual
L510005P-S1 - DTC Diagnostic Supplement
L510003 - 8.1L Engine Mechanical Service Manual
L510015 - 5.0/5.7L Engine Mechanical Service Manual
L510016 - 6.0L Engine Mechanical Service Manual
Drivability Checklist
Step 4 - Verify the problem

Refer to Figure 2-2. As you progress through the Drivability Checklist you can see that each step could go to a new troubleshooting tree or system for repair and correction of the owner provided symptom. As was previously discussed, there are certain symptoms or observations that require immediate attention prior to this step.

Figure 2-4 is a trouble tree for Step 4 of Drivability Checklist. As you can see from Figure 2-4, if an action performed fails you may have a new branch to follow to troubleshoot and repair the problem.

We want to “Take the Engine’s Pulse”, so to speak, before you go for a water test and verify the problem. You are going to need your senses, sight, hearing, and touch as much as you will need your tools, the Digital Multi-Meter (DMM), Diacom and Fuel Pressure Gauge, while performing these checks. This will be your first look at the various engine systems, working together, with a focus on troubleshooting the problem. Within a few minutes of testing, you may know the direction of your troubleshooting efforts.

NOTE: For illustrative purposes each test presumes the problem has not been resolved. Therefore, you proceed to the next step. In actual troubleshooting if any step corrects the problem there would be no reason to proceed further, you would verify your repair, Step 7 of the Drivability Checklist, and return the boat to its owner.

1. START the engine.

If the engine starts and continues to run you know you have fuel, spark and air. You have verified the boat to engine electrical interface, system power and grounds, battery, system fuses, all three system relays, fuel pump operation, and the ECM is functioning to start and run the engine. Your next step is the Water Test.

For other conditions, long crank, hard start, no start, stalling, etc., you will branch off to the No Start Troubleshooting Tree, Figure 2-5.

The No Start Troubleshooting Tree, incorporates the Key-On-Engine-Off (KOEO) test and other checks to determine the condition of the engine’s Electrical, Fuel, and ECM-07/08/08 systems. Each check is designed to get you to another troubleshooting tree to isolate the system and cause of the problem as quickly as possible.

2. Place the ignition switch in the Key-ON-Engine-OFF (KOEO) position. Ensure the boat’s safety lanyard is properly connected and the shift lever is in the neutral position. You should listen, feel and observe that the following actions take place:

   a. **Both fuel pumps run for 2-4 seconds.** Listen for each fuel pump and place your hand on each pump to verify that it is indeed running. Diacom may be used to cycle the fuel pumps, as necessary. If either or both fuel pumps fail to operate, you would branch to the Key-ON-Engine-OFF- Fuel Pump(s) Do Not Run - Troubleshooting Tree, Figure 2-12.

   b. **Observe the Fuel Pressure Gauge; fuel pressure should rise to near the wide-open-throttle (WOT) specification while the fuel pumps run.** If the pumps run but fuel pressure is not to specification, you would branch to the Fuel Pressure Out-of-Range Troubleshooting Tree, Figure 2-13.

   NOTE: The Fuel Pump and Pressure troubleshooting trees will be covered in detail under the Fuel System section.

You learn lot about the engine systems when you turn the ignition ON. The simple action of turning the key to the ON position has allowed you to check several engine systems simultaneously - Electrical, Fuel, and ECM-07/08/08. If the actions described previously occur, then you have verified the:

   a. Boat’s Ignition Switch,
   b. Boat’s Safety Lanyard circuit,
   c. Low and High Pressure Fuel pumps,
   d. Relay - Fuel Pump,
   e. 100A Engine Harness Fuse, ECM, VSW, and Fuel Pump Fuses,
   f. ECM powered up and functioned to turn on the fuel pumps,
   g. Battery voltage is at least 9.6 vdc*, and
   h. Power and ground circuits and related components are functioning.

NOTE: *The ECM may not power up if the battery voltage is less than 9.6 vdc.

3. **Engine cranking test.** Do Not turn the key to
"OFF" between the Key-ON-Engine-OFF test and this test. Place the ignition switch in the START position, for 25-30 seconds, to crank or roll over the engine. You should observe the following actions:

**NOTE:** Normal starter cranking RPM is 150-200 RPM. This can be observed on the Diacom display. If normal cranking RPM is not achieved, troubleshoot the starter for a slow crank condition.

- The engine cranks or rolls over for at least 25-30 seconds,
- The Fuel Pressure Gauge reading should rise to the same level observed during the Key-On-Engine-Off test. Fuel pressure rising is your indication that the fuel pumps are running.
- **IF** the engine does not start or starts and stalls, the fuel pumps should run for 2-4 seconds after the key is released from the START position. If the fuel pumps do not run for 2-4 seconds after the key is released, the ECM did not turn the fuel pumps on.

Refer to Figure 2-5. You would branch off and begin your checks with the Ignition fuse. Based on your result you may go on to do a System Power Check or Check the ECM for codes.

**NOTE:** Turning the key to the ‘START’ position resets the ECM which enables the fuel pumps for 2-4 seconds for prime. If the engine is failing to start, be sure to crank the engine for 5 seconds. You are checking to see if the ECM is receiving the Crankshaft Position Sensor (CKP) and Camshaft Position Sensor (CMP) signals which enable the fuel and ignition circuits. It is the CKP signal that causes the pumps to run for 2-4 seconds after you stop cranking the engine. Cranking for 5 seconds will ensure that a CMP, CKP, MAP (BP), or other code will be stored for a defective device. For troubleshooting, utilize the Diacom scan tool to observe Battery Voltage and Fuel Pump Output status while the engine cranks.

The action of turning the key "ON" then to the “START” position has allowed you to verify more of the operational capability of the three engine systems - Electrical, Fuel, and ECM-07/08/08. The additional circuit and component functions verified are:

- **Main Electrical System** – all of the Starter Circuit to include the starter relay, transmission neutral safety switch, starter, the associated power and grounds, the boat’s ignition and safety lanyard circuits, and the Battery meets the minimum system voltage requirements,
- **ECM-07/08/08 System** – if the fuel pumps run for 2-4 seconds after the key is released from the START position, the Crank Sensor signal is presumed to be present at the ECM enabling the ignition circuits and Fuel System.

Performing the No Start Troubleshooting Tree, typically, will get you back to the point where the engine will be running. You would complete Step 4 of the Drivability Checklist by water testing the boat. During the Water Test, you will be verifying two things:

4. **WATER TEST**

   (1) Verify the fuel pressure at WOT and under load.

   If fuel pressure is correct you have verified the fuel system all the way to the injectors. If the fuel pressure is incorrect, this may be the cause of your symptom, and you would go to the Fuel Pressure Out-Of-Range Troubleshooting Tree. Remember, it is absolutely essential to verify fuel pressure under load, at wide-open-throttle. This is the only reading that verifies the integrity of the fuel system.

   (2) Verify the reported symptom/problem.

   You will verify or revise the reported symptom, then proceed with the checklist to Step 5, the ECM-07/08/08 System Check.

   Refer to Figure 2-4, you can see that if an action failed we would go to another branch on the trouble tree.

   Should the engine crank normally but fail to start; you would branch off to the No Start Troubleshooting Tree, as we have discussed. From that tree you may branch into the Fuel System, Main Electrical System, or ECM-07/08 System based on your test results.
STEP 4
- VERIFY THE PROBLEM -
TAKING THE ENGINES PULSE

IMPORTANT:
FOR A REPORTED OVERHEAT OR MAIN ELECTRICAL SYSTEM PROBLEM, SUCH AS BATTERY, STARTER OR CHARGE SYSTEM PROBLEMS - STOP!
PERFORM OVERHEAT TROUBLESHOOTING OR MAIN ELECTRICAL SYSTEM TROUBLESHOOTING FIRST.

START THE ENGINE
The engine starts and runs.

NO
Refer to the No Start Troubleshooting Tree

YES
WATER TEST

 Fuel Pressure is to Specification
Under Load @ W.O.T.

NO
Refer to the Fuel Pressure-Out-Of-Range Troubleshooting Tree

YES
Verify the Owner reported problem.

NO
Symptom Revised. Diagnose to repair revised symptom.

VERIFIED
STEP 5 - ECM-07 SYSTEM CHECK

Figure 2-4 Verify the Problem - Taking the Engine’s Pulse
NO START
TROUBLESHOOTING TREE

Key-ON-Engine-OFF
Do Both Fuel Pumps Run 2-4 Seconds then turn off?

YES

Refer to the KOEO - Pump(s) Do Not Run - Troubleshooting Tree

NO

 Refer to the Fuel Pressure-Out-Of-Range Troubleshooting Tree

Is Fuel Pressure to Specification - while fuel pumps run?

YES

Crank the engine 5 seconds. Does the engine start and run?

NO

Go to applicable DTC table. Reference Voltage, Ignition Relay, Crank Sensor, Cam Sensor, and MAP (BP) Sensor Codes may be accompanied by a No Start symptom.

YES

Perform System Power Check

Replace open fuse and retest. Does the engine start and continue to run?

Return to Verify the Problem Troubleshooting Tree.

NO

Key-ON-Engine-OFF (KOEO). Is B+ present on both terminals of the Ignition, 15A fuse?

YES

Verify and repair short to ground in fused circuit. Replace open fuse.

NO

Crank the engine 5 seconds. Does the engine start and run?

YES

Replace open fuse and retest. Does the engine start and continue to run?

Return to Verify the Problem Troubleshooting Tree.

NO

Did the fuse open, again?

YES

Continue with Drivability Checklist
STEP 5 - ECM-07 SYSTEM CHECK

NO

CODES

No Start Troubleshooting Tree

NO

NO CODES

1. Drain the FCC of fuel.
2. Connect auxiliary fuel supply to the input of the LPFP and the fuel return of the FCC. Does the engine start and continue to run?

YES

If equipped, replace water separating fuel filter element. Troubleshoot/repair fuel supply pickup and/or replace fuel supply with fresh fuel.

NO

Return to Verify the Problem Troubleshooting Tree.

IMPORTANT:
USE THIS TROUBLESHOOTING TREE FOR THE CONDITION WHERE THE ENGINE CRANKS NORMALLY, BUT WILL NOT START AND CONTINUE TO RUN.
USE THE MAIN ELECTRICAL SYSTEM TROUBLESHOOTING TREES FOR SLOW CRANK OR NO CRANK TO TROUBLESHOOT STARTER ISSUES.
Drivability Checklist
Step 6 - Isolate and Repair the Problem.
Refer to Figure 2-6, The Drivability Checklist - No Codes Troubleshooting Tree, for Step 6A of the Drivability Checklist, Figure 2-3. This trouble tree follows the items listed under Step 6A on the Drivability Checklist. The first check is to review the data collected as you performed the first 5 steps of the checklist.

- Review the symptom information the owner/operator provided when you questioned him/her on recent events or service.
- Recheck the engine model and serial number.
- Recheck the Service Updates.
- Review your Visual Inspection.
- Recheck for accessories added.
- Review Step 4 “Verify The Problem”.
- Run another check for ECM-07/08/08 codes.

If a problem is found, correct that problem before proceeding. If you skipped any portion of the first 5 steps go back and perform those checks or inspections. After you verify that all steps, 1-5, have been properly completed and the results properly analyzed, proceed to step 6A-2.

Refer to Figure 2-3, Step 6A-2. An extremely important test is to verify the quality of the fuel in the boat. Sample the gasoline for water, diesel fuel, and other contaminants. This can be done by draining the FCC fuel bowl into an approved container for inspection.

If fuel system contamination is present or you suspect bad fuel, connect your auxiliary fuel tank to the engine, drain the FCC, and retest the boat. If performance returns to normal, you know you have a fuel quality and/or fuel availability problem. This test analyzes two problems fuel quality and fuel availability at the same time. Be careful not to misinterpret the results.

Remember, proper fuel pressure verifies the components of the fuel system not the quality of the fuel. Always inspect for fuel quality and utilize your auxiliary fuel tank to confirm your findings.

Step 6A-3, is to electrically isolate the engine from the boat. This is done using the RT0091 Test Switch. With the boat harness disconnected and the test switch in place you can operate the engine independent from the boat. Clear codes (if present) and retest. If the engine operates normally, you will have to troubleshoot and repair the boat wiring or systems that were interfering with proper engine operation.

With the increased sophistication in electronics, both engine and boat, it is not unusual for a boat system or wiring to interfere with proper engine operation. Typically, the source of the problem will be a loose or broken connection in the battery, ignition or ground circuits.

Step 6A-4, is to verify proper powertrain alignment. Improper powertrain alignment may affect boat and engine performance. The powertrain cannot be properly aligned if there is damage to the strut or shaft. When you performed the Visual Inspection, Step 3 of the Drivability Checklist, you should have inspected the boat for environmental factors that may cause a loss of engine or boat performance. If you did not perform those inspections do so before performing this step.

Steps 6A-5 – 6A-9, of Figure 2-2, are a series of inspections involving the ignition circuits.

Step 6A-5 - On 5.0/5.7L engines only, remove the distributor cap and inspect the cap and rotor for abnormal conditions.

Step 6A-6 - Check and record the resistance of each spark plug wire. Ignition wire resistance should not be greater than 10,000 ohms per foot. Record the results in the space provided on the Drivability Checklist, Figure 2-3. Leave the plug wires disconnected.

Step 6A-7 - Remove each spark plug and inspect for abnormal conditions such as:
- wrong type, size, reach, or heat range of the spark plug installed,
- improper gap,
- fouling, or
- physical damage.

Step 6A-8 - With all eight spark plugs removed, perform a compression check on all 8 cylinders. Record the results of the compression check in the space provided on the Drivability Checklist. Reinstall the spark plugs and ensure the ignition wires are all connected and routed properly.

Step 6A-9 - For 5.0/5.7L engines only, with the engine running at idle, verify CAM Retard is between 0-4 degrees using your Diacom scan tool. Adjust as required to set to the proper specification.

Steps 6A-10 – 6A-13 are made with the boat in the water.

Step 6A-10 - Whenever practical, if another boat of similar size, with the same engine package, is available, use it to verify and compare engine parameters for performance issues.

Step 6A-11 - Perform a Power Balance Test on the engine. The Power Balance Test is accessed using your Diacom scan tool. For best results, perform this test with the engine under load, running between 1600 - 1800 RPMs. This test can isolate a coil/ignition module circuit and/or fuel injector circuit problem to a specific cylinder. You would then troubleshoot the cylinder which failed this check.

NOTE: The Diacom Power Balance Test will be discussed in more detail in the ECM-07/08/08 Section, Section 6, under Diacom Test Features.

Step 6A-12 - Perform the engine harness “Wiggle Test”.

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With the engine running, start at the boat/engine harness 2 and 8 pin connectors and wiggle the harness. Move forward along the starboard side wiggling the harness at sensor, injector and coil connections. Then repeat for the port side of the harness. A change in engine operation indicates a wiring defect in the area where the wires were wiggled. Repair wiring or connections as required.

Step 6A-13 - The final test to perform is to record the Pre-Delivery Inspection test run. Review this Diacom data file against similar new engine Pre-Delivery Diacom recordings. Look for data that is out of range versus new engine data. Troubleshoot and repair circuits that read out of range. File this test and all relative information in the customer’s service and/or sales file(s).

Completing the steps on your Drivability Checklist, through step 6A, will locate most symptomatic problems. Be sure to record all your findings as you perform the Drivability Checklist. If you have completed the Drivability Checklist through Step 6A, and have not found and resolved the problem:

**STOP** - call the PCM Technical Service Department for assistance. PCM Warranty and Service Department: 803-345-0050.

Have your completed Drivability Checklist and Diacom recording readily available, then call the PCM Technical Service Department for assistance. You may be requested to fax or e-mail a copy of the checklist to the Technical Service Department during your discussion with the factory service representative.
**STEP 6A**

**DRIVABILITY CHECKLIST - NO CODES**

- Review the results of Steps 1-5
- Inspect or correct recent service work performed.
- Inspect fuel for contamination - water, correct fuel type, etc.
- Connect Auxillary Fuel Supply and retest.
- Correct fuel/fuel system as necessary.
- Isolate boat wiring from engine. Install RT0091 Test Switch.
- Connect Diacom and Clear Codes. Retest.
- Correct Boat electrical wiring as required.
- Verify powertrain alignment.
- Correct alignment as required.
- Remove and Inspect the Distributor Cap and Rotor. (5.0/5.7L Only)
- Replace Cap and Rotor as necessary.
- Ignition Wire Resistance check Record results.
- Replace spark plug wires as necessary.
- Remove and Inspect each spark plug for damage or abnormal condition.
- Replace spark plugs as necessary.
- Perform a Compression Check on all 8 cylinders and record.
- Refer to the Engine Mechanical Service Manual.

**WATER TEST**

- Verify Cam Retard (5.0/5.7L only)
- Adjust as required.
- Performance verified against a similair boat w/same engine package
- Same
- Normal operation.
- Perform the Diacom Power Balance Test.
- Refer to the ECM-07 Diagnostic Manual
- Perform the harness Wiggle Test.
- Isolate and repair wiring or connector problems.
- Pre-Delivery Diacom recording.
- Isolate and repair circuits outside of normal parameters.

*Figure 2-6 Drivability Checklist - No Codes*
Dead Battery, Charge System Problems, No Crank, Slow Crank or any problem related to the main system power.

SYSTEM POWER CHECK TROUBLESHOOTING TREE

STARTER CIRCUIT TROUBLESHOOTING TREE

NO CRANK TROUBLESHOOTING TREE

CHARGE CIRCUIT TROUBLESHOOTING TREE

SLOW CRANK TROUBLESHOOTING TREE
**SYSTEM POWER CHECK**

**TROUBLESHOOTING TREE**

---

**Key-OFF**
Verify that the battery is the correct size, rating, and fully charged. Battery charge needs to be verified using a load tester.

- Replace Battery with a known good battery of the correct size and rating.

**Verify continuity of the 100A Fuse Link between the Starter and Alternator battery terminals.**

- **No**
  - Replace 100A Fuse Link

- **Yes**
  - Inspect, clean, and repair as required battery terminals and connections. Connect Battery.

  **NOTE:** Ground locations are critical for proper engine operation. Refer to the Main System Power - Grounds Diagram for device and ground locations. Ensure only the ECM / Engine harness is grounded at the Port ground stud.

  **Replace fuse(s), Inspect, clean and repair connections or wiring that are not within specification. If TP-3 through TP-8 are 0.0 vdc, disconnect the battery and verify 100A fuse link between Pin 1 of each fuse and the Starter battery connection. If open, replace engine harness.**

**Inspect, clean, and repair as required engine ground connections.**

---

**Key ‘ON’ and boat lights ON. Verify voltage is not less than .3 vdc of battery voltage at each system power test point.**

Refer to Main System Power - Test Points Diagram.

---

**Continue to Starter Circuit, Charge Circuit or return to the diagnostic procedure that requested a System Power Check.**

---

**Figure 2-8 System Power Troubleshooting Tree**

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When you perform the Visual Inspection include the Starter Circuit, exhaust system to include physical damage, missing exhaust flaps, and exhaust restrictions. Remove all 8 spark plugs and inspect for evidence of fluid in the cylinders. Ensure the shift lever is in Neutral position.

Correct conditions with the exhaust system. Continue with Starter Circuit trouble tree and verify starter operation.

Was fluid found in cylinders and/or on the spark plugs?

Dry

Wet

Check for Fuel Injector Codes and ECT Over-Temp Codes.

Codes Present

Perform Diagnostic Procedure for the Code(s) present.

Water/Coolant Present

Pressure check exhaust manifolds and elbows for leaks.

Replace faulty exhaust manifold or elbow, if good-Troubleshoot and repair engine mechanical.

Fuel Present

Perform the DTC Fuel Injector troubleshooting procedure for the failed injector circuit.

Disable fuel and spark by enabling Diacom Compression Test feature. Key Switch to ‘START’ position

Once the condition that allowed fluid into the cylinders is repaired. Disable fuel and spark by enabling Diacom Compression Test feature. Perform a compression check on all 8 cylinders to verify no other engine damage is present.

Normal

Slow Crank

No Crank

Pass

Fail

Perform a compression check on all 8 cylinders.

Re-Install spark plugs

Go To Slow Crank Trouble Tree

Go To No Crank Trouble Tree

Perform System Power Check

Figure 2-9 Starter Circuit Troubleshooting Tree
When you have completed your troubleshooting and repair of the starter, be sure to disable the Diacom Compression Test feature, then verify the engine starts and runs.
When you have completed your troubleshooting and repair of the starter, be sure to disable Diacom Compression Test feature, then verify the engine starts and runs.

Figure 2-11 Starter Circuit - No Crank
**KEY-ON-ENGINE-OFF - FUEL PUMP(S) DON'T RUN - TROUBLESHOOTING TREE**

Key-ON-Engine-OFF (KOEO).

**Is B+ present on both terminals of the following fuses?**

**Fuel Pump**, 20A  
**ECM**, 20A  
**VSW**, 5A  
**Ignition**, 15A

**NO**

**Perform System Power Check**

**Replace open fuse and retest.**  
Does the engine start and continue to run?  
**YES**  
**Return to Verify the Problem troubleshooting tree.**  
**NO**

**Did the fuse open, again?**  
**YES**  
**Verify and repair short to ground in fused circuit. Replace open fuse.**  
Does the engine start and continue to run?  
**NO**

Key-ON-Engine-OFF. Connect Diacom and check for stored codes.

**Code**

**Perform Diagnostic Procedure for the Code(s) present.**

**No Code**

**Enable Diacom Relay Test - All.**  
Verify B+ at both Fuel Pump connectors.

**YES**

**Verify and repair connections between fuel pump and harness connector.**  
If good, replace fuel pump.  
Verify repair.

**NO**

**Disable Diacom Relay Test - All.**

**Remove Fuel Pump Relay.**  
Verify battery voltage at fuel pump relay socket pin 30 and pin 86.

**YES**

**Repair connection between fuse and pin 30 or pin 86.**

**NO**

**Jumper relay socket pin 30 to 87. Do both fuel pumps run?**  
**YES**  
**Connect a test light between pin 86 and 85. Cycle fuel pumps.**  
Test light lights for 2-4 seconds.  
**YES**  
**Replace Fuel Pump Relay.**  
Verify repair.

**NO**

**Verify battery voltage at fuel pump connector.**

**NO**

**Repair harness between fuel pump and Fuel Pump Relay socket.**  
Verify repair.

**YES**

**Verify and repair connections between fuel pump and harness connector.**  
If good, replace fuel pump.  
Verify repair.

**Key OFF. Unplug ECM-07 connector J1. KOEO - Verify battery voltage at ECM connector J1-60, J1-79 and J1-45. Verify continuity between relay socket pin 85 and ECM J1-84. Repair circuit and retest, if circuits and connections are good, replace ECM.**  
Verify repair.

**When repair is complete, return to the procedure that called out this trouble tree.**

*IMPORTANT:* Prior to use, verify that the test lamp’s current draw is less than 3/10 (.3A) amps. The use of a test lamp that does not meet this requirement may damage sensitive electronic components.
KEY-ON-ENGINE-OFF
FUEL PRESSURE OUT OF RANGE - PUMPS RUN

Below Specification

Do Both fuel pumps run for 2-4 seconds at KOEO?

NO

Perform KOEO Fuel Pumps Don't Run Troubleshooting Tree, first.

YES

Verify LPFP output volume.

Low Pressure Fuel Pump Volume Test

1. Disconnect the return-to-tank fuel line from the FCC.
2. Connect a piece of fuel line between the FCC return output and an approved empty container.
3. Remove the Fuel Pump Relay.
4. Jumper relay socket Pin 30 to Pin 87 for 10 seconds, then disconnect jumper.
5. Verify 16-20 oz. of fuel in the container.
6. Return system to normal configuration.

FAIL

Inspect/clean Pre-Filter at inlet of the LPFP. Repeat the LPFP volume check.

PASS

FAIL

Connect an auxiliary fuel tank to the input of the LPFP.

Repeat fuel pump volume test.

Fuel volume to spec?

PASS

Troubleshoot and repair fuel restriction on supply (inlet) side of the LPFP. Verify repair.

FAIL

Replace LPFP. Verify repair.

Above Specification

Connect an auxiliary fuel tank between the LPFP (inlet) and FCC (return).

Cycle the fuel pumps. Verify fuel pressure.

At Specification

Troubleshoot and repair restriction in fuel return line from FCC to the fuel tank. Verify repair.

When repair is complete, return to the procedure that called out this trouble tree.

Above Specification

Replace Fuel Pressure Regulator. Verify repair.

Figure 2-13 Fuel System - Fuel Pressure Out-Of-Range
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<table>
<thead>
<tr>
<th>Diagnostic Trouble Code (DTC)</th>
<th>Suspect Parameter Number (SPN)</th>
<th>Failure Mode Identifier (FMI)</th>
<th>Fault Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC 107</td>
<td>106</td>
<td>4</td>
<td>MAP voltage low</td>
</tr>
<tr>
<td>DTC 108</td>
<td>106</td>
<td>16</td>
<td>MAP pressure high</td>
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<td>DTC 11</td>
<td>520800</td>
<td>7</td>
<td>Distributor Position Error</td>
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<tr>
<td>DTC 111</td>
<td>105</td>
<td>15</td>
<td>IAT higher than expected stage 1</td>
</tr>
<tr>
<td>DTC 1111</td>
<td>515</td>
<td>16</td>
<td>RPM above fuel rev limit level</td>
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<td>DTC 1112</td>
<td>515</td>
<td>0</td>
<td>RPM above spark rev limit level</td>
</tr>
<tr>
<td>DTC 112</td>
<td>105</td>
<td>4</td>
<td>IAT voltage low</td>
</tr>
<tr>
<td>DTC 1121</td>
<td>91</td>
<td>31</td>
<td>FPP1/2 simultaneous voltages out-of-range (redundancy lost)</td>
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<td>520199</td>
<td>11</td>
<td>FPP1/2 do not match each other or IVS (redundancy lost)</td>
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<td>105</td>
<td>3</td>
<td>IAT voltage high</td>
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<td>Cylinder 8 misfire detected</td>
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<td>EGO1 open / lazy</td>
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<tr>
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<td>3256</td>
<td>5</td>
<td>EGO3 open / lazy</td>
</tr>
<tr>
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<td>441</td>
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<td>EMWT1 higher than expected stage 1</td>
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<td>DTC 1416</td>
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<td>EMWT2 higher than expected stage 1</td>
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<td>DTC 1417</td>
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<td>AUX analog Pull-Up/Down 1 low voltage           (Transmission Temp.)</td>
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<td>DTC 1613</td>
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<td>Microprocessor failure - A/D</td>
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<td>DTC 174</td>
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<td>Unable to reach lower TPS</td>
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<td>DTC 2112</td>
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<td>Unable to reach higher TPS</td>
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<td>DTC 2116</td>
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<td>VID</td>
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<td>IVS stuck at-idle, FPP1/2 match</td>
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<td>IVS stuck off-idle, FPP1/2 match</td>
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<td>TPS1/2 simultaneous voltages out-of-range</td>
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<td>Injector 8 open or short to ground</td>
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<td>Catalyst inactive on gasoline (Bank 2)</td>
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<td>Fuel pump relay coil open</td>
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<td>Fuel-pump high-side open or short to ground</td>
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<td>DTC 685</td>
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<td>DTC 687</td>
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<td>Power relay coil short to power</td>
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</table>
Ballast Tank Level / Fuel Level Diagnostics

- Ballast Level / Fuel Level - LINC System
- Check Condition - None
- Fault Condition - None

On some models, the fuel level and/or ballast tank levels are inputs to the ECM. The ECM converts the data and outputs a percentage level on the CAN BUS. Faults to these circuits do not set diagnostic trouble codes. The following chart will aid in determining the fault within one of these level circuits.
Ballast Tank Level / Fuel Level Diagnostics

Engine Off

- Disconnect Sending Unit Connector.
- Disconnect ECM Connector.
- Using a DMM, check for continuity between the sending unit connector ground and ECM terminal “20.”

Does DMM indicate good continuity?

No

- Repair bad connection or open circuit between suspect sending unit connector and ECM terminal “20.”

Yes

- Using a DMM, check for continuity between the sending unit connector signal wire and the corresponding ECM terminal.

Does DMM indicate good continuity?

No

- Repair bad connection or open/grounded circuit between suspect sending unit connector and ECM terminal.

Yes

- Using a DMM, check for continuity between the two sending unit connector wires.

Does DMM indicate good continuity?

No

- Repair faulty sending unit.

Yes

- Make sure the resistance changes when the level is changed.
- If OK, replace faulty ECM.
DTC 0011 - Distributor Alignment Error - 5.0 / 5.7L Engines Only
SPN - 520800; FMI - 7

• Distributor Alignment (Position)
• Check Condition - Engine Running
• Fault Condition - Engine distributor position is greater than 10 degrees from specification
• Corrective Action(s) - Illuminate MIL and/or sound audible warning
• Emissions related fault

The camshaft position sensor is a magnetic sensor installed in the distributor on 5.0/5.7L engines adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression).

The cam position, or distributor alignment, must be within 10 degrees of specification. If this position is off by more than the 10 degrees, the MIL will be illuminated and some ignition “cross firing” may occur at certain RPM and load conditions.
DTC 0011 - Distributor Alignment Error - 5.0 / 5.7L Engines Only
SPN - 520800; FMI - 7

Engine Running

Does DST display CAM Retard within 10 degrees of specification?

- Yes
  - Intermittent Problem

- No
  - Loosen the distributor hold down bolt
  - Rotate distributor until the correct CAM Retard is achieved
  - Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification

No Engine Running

Does DST display CAM Retard within 10 degrees of specification?

- Yes
  - Intermittent Problem

- No
  - Loosen the distributor hold down bolt
  - Rotate distributor until the correct CAM Retard is achieved
  - Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification
DTC 0016 - Crank and/or Cam Could Not Synchronize During Start
SPN - 636; FMI - 8

- Crankshaft Position Sensor/Camshaft Position Sensor
- **Check Condition** - Engine Cranking or Running
- **Fault Condition** - Engine rotates without crank and/or cam synchronization
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Emissions related fault

The crankshaft position sensor is a magnetic sensor installed in the engine block adjacent to a “coded” trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The camshaft position sensor is a magnetic sensor installed in the engine block or valve train adjacent to a “coded” trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

The ECM must see a valid crankshaft position and camshaft position signal properly aligned during cranking before it can synchronize the injection and ignition systems to initiate starting. If engine speed > 90 RPM and the crank and cam can not synchronize within 4.0 cranking revs, this fault will set. Typically, this fault will result in an engine that will not start or run.
DTC 0016 - Crank and/or Cam Could Not Synchronize During Start  
SPN - 636; FMI - 8

<table>
<thead>
<tr>
<th>Diagnostic Aids</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Check that crankshaft and/or camshaft position sensor(s) are securely connected to the harness</td>
</tr>
<tr>
<td>☐ Check that crankshaft and/or camshaft position sensor(s) are securely installed into engine block</td>
</tr>
<tr>
<td>☐ Check crankshaft and/or camshaft position sensor(s) circuit(s) wiring for an open circuit</td>
</tr>
</tbody>
</table>
DTC 0107 - MAP Sensor Circuit Low Voltage
SPN - 106; FMI - 4

- Manifold Absolute Pressure Sensor
- Check Condition - Engine Cranking or Running
- Fault Condition - MAP sensor voltage feedback less than 0.10 volts when throttle position is greater than 2.0% and engine speed is less than 7000 RPM.
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, recommend power derate 1, disable adaptive learn fueling correction for key-cycle, or any combination thereof as defined in calibration.
- Emissions related fault

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the engine, which thereby determines the required fuel flow rate.

This fault will set when the MAP sensor voltage feedback is sensed as lower than 0.10 volts. In many cases, this condition is caused by the MAP sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the MAP circuit in the wire harness, a loss of sensor reference voltage, or a failure of the sensor. When this fault occurs, the ECM operates in a limp home mode in which an estimated MAP based on TPS feedback is used to fuel the engine. Recommended corrective actions include setting power derate 1, disabling adaptive learn for the remainder of the key-on cycle with closed-loop remain enabled, and outputting a warning to the user.

If the MAP sensor is integrated in a TMAP sensor and an IAT High Voltage fault (DTC 113) is also present, the sensor is likely disconnected from the wire harness.
Engine Running

Does DST display MAP voltage < 0.10 volts with engine idling?

Yes

Key ON, Engine OFF

- If DTC 642 or 643 are present, troubleshoot those first
- Using a DMM, measure the voltage between 5Vref and 5Vrtn at the MAP sensor connector

No

Intermittent Problem

- Faulty harness (check 5Vref and 5Vrtn connections)
- Faulty ECM (5Vref power supply)

Does DMM indicate a voltage > 4.7 volts?

No

- Poor connection at sensor
- Faulty MAP sensor

Yes

- Jumper the MAP sensor signal circuit to 5Vref at MAP sensor harness connector

Does DST display MAP voltage > 4.7 volts?

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on MAP signal circuit between the ECM connector and MAP sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Yes

- Faulty Harness

Is the resistance < 5 ohms?

No

- Faulty Harness

Yes

- Reconnect ECM connector
- Key ON, Engine OFF
- Probe MAP sensor signal circuit with a test light connected to battery voltage

Does DST display MAP voltage of 4.0 volts or greater?

No

- MAP sensor signal circuit shorted to ground
- Faulty ECM connection
- Faulty ECM (analog input circuit)

Yes

- Faulty ECM connection
- Faulty ECM (analog input circuit)
• Manifold Absolute Pressure Sensor
• Check Condition - Engine Cranking or Running
• Fault Condition - MAP is higher than 14.00 psia when throttle position is less than 10% and engine speed is greater than 1800 RPM.
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, or any combination thereof as defined in calibration. Power derate is sometimes used with this fault.
• Emissions related fault

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used as an index for spark, fuel, base fuel, etc. and is used in conjunction with other inputs to determine the airflow rate to the engine. The airflow rate in conjunction with the base fuel command determines the fuel flow rate.

This fault will set when the MAP reading is higher than it should be for the given TPS, and RPM. When the fault is set the engine will typically operate in a “limp home” mode using an estimated MAP based on TPS feedback. It is recommended that Adaptive Learn be disabled to prevent improper learning and population of the table. In addition, power derate is sometimes used.
Engine Running
If engine idle is rough, unstable, missing or incorrect due to a suspected engine mechanical problem or vacuum leak, etc., correct the condition before continuing with this chart.

Does DST display MAP pressure >14.00 psia with engine idling?
Yes

- Key OFF
- Disconnect MAP sensor electrical connector
- Key ON, Engine OFF

No

Interruption Problem

Does DST display MAP pressure >14.00 psia with engine idling?
Yes

- Key OFF
- Disconnect MAP sensor electrical connector
- Key ON, Engine OFF

No

Does DST display MAP voltage < 0.10 volts?
Yes

- Probe sensor ground circuit with test light connected to battery voltage

No

- MAP sensor signal circuit shorted to voltage
- Faulty ECM

Does test light illuminate?
Yes

- Faulty MAP sensor pressure connection to intake manifold
- Faulty MAP sensor
- Faulty ECM connection

No

- Open sensor ground circuit
- Faulty ECM

DTC 0108 - MAP Sensor Circuit High Pressure
SPN - 106; FMI - 16
DTC 0111 - IAT Higher Than Expected Stage 1
SPN - 105; FMI - 15

- Intake Air Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Intake Air Temperature greater than 200 degrees F at an operating condition greater than 1500 RPM.
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction while fault is active, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to detonation.
- Non-emissions related fault

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

This fault will set if the Intake Air Temperature is greater than 200 degrees F and the operating condition is at a speed greater than 1500 RPM.
DTC 0111 - IAT Higher Than Expected Stage 1
SPN - 105; FMI - 15

Diagnostic Aids

☐ This fault will set when inlet air is hotter than normal. The most common cause of high inlet air temperature is a result of a problem with routing of the inlet air. Ensure inlet plumbing sources are external, is cool, and is not too close to the exhaust at any point.

☐ Inspect the inlet air system for cracks or breaks that may allow unwanted underhood air to enter the engine.

☐ If no problem is found, replace the IAT sensor with a known good part and retest.
DTC 0112 - IAT Sensor Circuit Low Voltage
SPN - 105; FMI - 4

- Intake Air Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - IAT sensor voltage less than 0.050 volts
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend power derate 1/2 to reduce possible detonation and engine damage due to high intake charge temperatures that can not be sensed.
- Non-emissions related fault

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the ECT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine.

This fault will set if the signal voltage is less than 0.050 volts. The ECM will use a default value for the IAT sensor in the event of this fault.
DTC 0112 - IAT Sensor Circuit Low Voltage  
SPN - 105; FMI - 4

Ignition ON, Engine OFF

Does DST display IAT Temperature > 260 F?  
Yes

• Key OFF  
• Disconnect IAT sensor electrical connector  
• Key ON, Engine OFF

No

Intermittent Problem

Does DST display IAT Temperature < 0 F?  
Yes

• Using a DMM, check for IAT sensor signal circuit shorted to ground  
• Was a problem found?

No

Replace faulty ECM.

Yes

Replace faulty IAT sensor  

No

Repair faulty IAT signal circuit as necessary.

Does DST display IAT Temperature > 260 F?  
Yes

• Key OFF  
• Disconnect IAT sensor electrical connector  
• Key ON, Engine OFF

No

Intermittent Problem
DTC 0113 - IAT Sensor Circuit High Voltage
SPN - 105; FMI - 3

- Intake Air Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - IAT sensor voltage greater than 4.95 volts
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn and closed-loop fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to detonation.
- Non-emissions related fault

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the ECT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine.

This fault will set if the signal voltage is higher than 4.95 volts anytime the engine is running. In many cases, this condition is caused by the IAT sensor being disconnected from the engine harness, an open-circuit or short-to-power of the IAT circuit in the wire harness, or a failure of the sensor. The ECM will use a default value for the IAT sensor in the event of this fault.
Key ON, Engine OFF

Does DST display IAT Temperature < 0°F?

Yes

• Disconnect IAT sensor electrical connector
• Jumper across the terminals at connector

No

Intermittent Problem

Does DST display IAT Temperature > 260°F?

Yes

• Faulty connection to sensor
• Faulty IAT sensor

No

Jumper IAT sensor signal to known good ground

Does DST display IAT Temperature > 260°F?

Yes

• Open IAT sensor ground (5Vrtn) circuit
• Faulty connection to sensor
• Faulty IAT sensor

No

• Key OFF
• Disconnect wiring harness connector from ECM
• Carefully remove the yellow lock from the connector
• CAREFULLY check resistance on IAT signal circuit between the ECM connector and IAT sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms?

Yes

• Faulty ECM connection
• Faulty ECM

No

Intermittent Problem
DTC 0116 - ECT Higher Than Expected Stage 1
SPN - 110; FMI - 15

- Engine Coolant Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Engine Coolant Temperature reading greater than 200 degrees F when operating at a speed greater than 600 RPM
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.
- Non-emissions related fault

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. This is used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds 200 deg. F and engine RPM exceeds 600 RPM for 60 seconds this fault will set.
**Diagnostic Aids**

- If the “ECT High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “ECT Higher Than Expected 1.”
- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking
- Ensure that there is no trapped air in the cooling path
- Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free
- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected
- Check that the thermostat is not stuck closed
- Check that the raw water pump/impeller is tact and that it is not restricted
DTC 0117 - ECT Sensor Circuit Low Voltage
SPN - 110; FMI - 4

- Engine Coolant Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - ECT sensor voltage less than 0.050 volts
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.
- Non-emissions related fault

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. This is used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will set if the signal voltage is less than 0.050 volts. The ECM will use a default value for the ECT sensor in the event of this fault.
DTC 0117 - ECT Sensor Circuit Low Voltage
SPN - 110; FMI - 4

Ignition ON, Engine OFF

Does DST display ECT Temperature > 260 F? Yes
• Key OFF
• Disconnect ECT sensor electrical connector
• Key ON, Engine OFF

No
Intermittent Problem

Does DST display ECT Temperature < 0 F? Yes
Replace faulty ECT sensor

No

Does DST display ECT Temperature < 0 F? Yes
• Using a DMM, check for ECT sensor signal circuit shorted to ground
• Key OFF
• Disconnect ECT sensor electrical connector
• Key ON, Engine OFF
• Using a DMM, check for ECT sensor signal circuit shorted to ground
• Was a problem found?

No
Replace faulty ECM.

Yes
Repair faulty ECT signal circuit as necessary.
• Engine Coolant Temperature Sensor
• Check Condition - Engine Running
• Fault Condition - ECT sensor voltage higher than 4.95 volts
• Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.
• Non-emissions related fault

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. This is used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will set if the signal voltage is higher than 4.95 volts. In many cases, this condition is caused by the ECT sensor being disconnected from the engine harness, an open-circuit or short-to-power of the ECT circuit in the wire harness, or a failure of the sensor. The ECM will use a default value for the ECT sensor in the event of this fault.
Key ON, Engine OFF

Does DST display ECT Temperature < 0°F?

Yes

- Disconnect ECT sensor electrical connector
- Jumper across the terminals at connector

No

Intermittent Problem

Does DST display ECT Temperature > 260°F?

Yes

- Faulty connection to sensor
- Faulty ECT sensor

No

Jumper ECT sensor signal to known good ground

Does DST display ECT Temperature > 260°F?

Yes

- Open ECT sensor ground (5Vrtm) circuit
- Faulty connection to sensor
- Faulty ECT sensor

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on ECT signal circuit between the ECM connector and ECT sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms?

Yes

- Faulty ECM connection
- Faulty ECM
DTC 0121 - TPS1 % Lower Than TPS2 %
SPN - 51; FMI - 1

- Throttle Body - Throttle Position Sensor 1 & 2 (electronic throttle body only)
- Check Condition - Key-On, Engine Cranking, or Running
- Fault Condition - TPS1 lower than TPS2 by 20%
- Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, shutdown engine
- Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effectors) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS1 % is lower than TPS2 % by 20%. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. During this active fault, an audible/visual alert device is activated and either an engine shutdown should be triggered or throttle control is set to use the higher of the two feedback signals for control in combination with a low rev limit and/or power derate.
DTC 0121 - TPS1 % Lower Than TPS2 %
SPN - 51; FMI - 1

- Key ON, Engine OFF
- Using DST, enable DBW Test Mode
- Slowly move the throttle handle

Is TPS1 and TPS2 difference more than 20%?

Yes

- Key OFF
  - Disconnect TPS electrical connector from throttle body
  - Key ON, Engine OFF
  - Using DST, enable DBW Test Mode

Is the voltage for both TPS1 and TPS2 < 0.10 volts?

Yes

- Jumper TPS1 signal circuit to the 5Vref at the harness connector while observing TPS1 voltage
- Repeat for TPS2

No

- TPS signal circuit (the one over 0.10 volts) is shorted to voltage
- Faulty ECM

Does DST display both TPS1 and TPS2 voltage over 4.90 volts when each is connected to 5Vref?

Yes

- Faulty connection at TPS
- Faulty TPS

No

- Key OFF
  - Disconnect wiring harness connector from ECM
  - Carefully remove the yellow lock from the connector
  - CAREFULLY check resistance on TPS1 and TPS2 signal circuits between the ECM connector and TPS connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Are both resistances < 5 ohms?

Yes

- TPS1 or TPS2 signal circuit shorted to ground
- Faulty ECM connection
- Faulty ECM

No

- Faulty Harness

Intermittent Problem
DTC 0122 - TPS1 Signal Circuit Voltage Low
SPN - 51; FMI - 4

• Throttle Body - Throttle Position Sensor 1
• Check Condition - Key On, Engine Cranking or Running
• Fault Condition - TPS1 sensor voltage lower than 0.20 volts
• Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, shutdown engine
• Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS1 voltage is lower than 0.20 volts at any operating condition while the engine is cranking or running. In many cases, this condition is caused by the TPS sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TPS circuit in the wire harness, or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.
DTC 0122 - TPS1 Signal Circuit Voltage Low
SPN - 51; FMI - 4

- Key ON, Engine OFF
- Using DST, enable DBW Test Mode

Is TPS1 voltage low (<1.0 volt) at 0% TPS by design?

Yes

Does DST display TPS1 voltage < 0.2 volts with the throttle open?

Yes

Does DST display TPS1 voltage < 0.2 volts with the throttle closed?

Yes

- Key OFF
- Disconnect TPS electrical connector

No

- Jumper 5Vref to TPS1 signal circuit at the TPS connector
- Key ON, Engine OFF

No

Does DST display TPS1 voltage > 4.0 volts?

Yes

Yes

- Faulty TPS harness connection
- Faulty TPS

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector

- CAREFULLY check resistance on TPS1 signal circuit between the ECM connector and TPS connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

- TPS1 signal circuit shorted to ground
- Faulty ECM connection
- Faulty ECM
- Faulty TPS

No

Is the resistance < 5 ohms?

Yes

No

- Faulty Harness
DTC 0123 - TPS1 Signal Circuit Voltage High
SPN - 51; FMI - 3

- Throttle Body - Throttle Position Sensor 1
- Check Condition - Key On, Engine Cranking or Running
- Fault Condition - TPS1 sensor voltage higher than 4.80 volts
- Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, shutdown engine
- Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS1 voltage is higher than 4.80 volts. In many cases, this condition is caused by a short-to-power of the TPS circuit in the wire harness or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.
DTC 0123 - TPS1 Signal Circuit Voltage High
SPN - 51; FMI - 3

- Key ON, Engine OFF
- Using DST, enable DBW Test Mode

- Slowly move the throttle handle while observing TPS1 voltage

- Key OFF
- Disconnect TPS electrical connector
- Key ON, Engine OFF

- Probe TPS1 sensor ground circuit at harness connector with test light connected to battery voltage

- Faulty TPS connection
- Faulty TPS

- Open sensor ground circuit
- Faulty ECM

- TPS1 signal circuit shorted to voltage
- Faulty ECM

- Yes
- Does TPS1 voltage ever exceed 4.80 volts?

- Yes
- Does DST display TPS1 voltage > 0.20 volts?

- No
- Does DST display TPS1 voltage < 4.80 volts?

- Yes
- Does DST display TPS1 voltage > 4.80 volts with the throttle closed?

- No
- Slowly release the throttle handle while observing TPS1 voltage

- Yes
- Does DST display TPS1 voltage > 4.80 volts with the throttle open?

- No
- Slowly release the throttle handle while observing TPS1 voltage

- Does DST display TPS1 voltage > 4.80 volts?

- No
- Does TPS1 voltage ever exceed 4.80 volts?

- Yes
- Does the test light illuminate?

- No
- Intermittent Problem

- Faulty TPS connection
- Faulty TPS
DTC 0127 - IAT Higher Than Expected Stage 2
SPN - 105; FMI - 0

- Intake Air Temperature Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Intake Air Temperature greater than 210 degrees F at an operating condition greater than 1500 RPM.
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction while fault is active, or any combination thereof as defined in calibration.
- Non-emissions related fault

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

This fault will set if the Intake Air Temperature is greater than 210 degrees F and the operating condition is at a speed greater than 1500 RPM.
DTC 0127 - IAT Higher Than Expected Stage 2
SPN - 105; FMI - 0

Diagnostic Aids

☐ This fault will set when inlet air is hotter than normal. The most common cause of high inlet air temperature is a result of a problem with routing of the inlet air. Ensure inlet plumbing sources are external, is cool, and is not too close to the exhaust at any point.

☐ Inspect the inlet air system for cracks or breaks that may allow unwanted underhood air to enter the engine.

☐ If no problem is found, replace the IAT sensor with a known good part and retest.
DTC 0129 - Barometric Pressure - Low Pressure
SPN - 108; FMI - 1

- Barometric Pressure
- **Check Condition** - Key On, Engine Off or after BP estimate during low-speed/high load operation
- **Fault Condition** - Barometric Pressure is less than 8.30 psia
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle
- Emissions related fault

Barometric Pressure is estimated from the MAP sensor at key-on and in some calibrations during low speed/high load operation as defined in the engine’s calibration. The barometric pressure value is used for fuel and airflow calculations and equivalence ratio targets based on altitude.

This fault sets if the barometric pressure is lower than 8.30 psia as defined in the diagnostic calibration.
DTC 0129 - Barometric Pressure - Low Pressure
SPN - 108; FMI - 1

- Key ON, Engine OFF

Does DST display BP < 8.3 psia (57 kPa)?

No

Intermittent Problem

Yes

- Key OFF
- Disconnect MAP sensor electrical connector
- Jumper the MAP sensor signal circuit to 5Vref circuit at the connector
- Key ON, Engine OFF

- Key OFF
- Disconnect MAP sensor electrical connector
- Jumper the MAP sensor signal circuit to 5Vref circuit at the connector
- Key ON, Engine OFF

Does DST display BP > 14.0 psia (96.5 kPa)?

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on MAP sensor signal circuit between the ECM connector and MAP connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Yes

- Poor connection at MAP sensor
- Faulty MAP sensor

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on MAP sensor signal circuit between the ECM connector and MAP connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms?

No

- Faulty Harness

Yes

- Reconnect ECM connector
- Key ON, Engine OFF
- Probe MAP sensor signal circuit with a test light connected to battery voltage

Is the resistance < 5 ohms?

Yes

- 5 volt reference circuit is open or shorted to ground
- Faulty ECM connection
- Faulty ECM

No

- BP/MAP signal circuit shorted to ground
- Faulty ECM connection
- Faulty ECM
**DTC 0134 - Heated Exhaust Gas Oxygen 1 (HEGO1) Sensor Circuit Open/Lazy**

**SPN - 3217; FMI - 5**

- **Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)**
- **Check Condition - Engine Running**
- **Fault Condition - HEGO cold longer than 120 seconds**
- **Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.**
- **Emissions related fault**

The HEGO sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes.

This fault will set if the sensor element is cold, non-responsive, or inactive for 120 seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback. This fault should disable closed-loop when it is active and adaptive learn for the key-cycle.
DTC 0134 - Heated Exhaust Gas Oxygen 1 (HEGO1) Sensor Circuit Open/Lazy
SPN - 3217; FMI - 5

- Engine Running
- Warm engine to normal operating temperature (ECM must have been powered for > 5 minutes)
- Using DST, ensure that Closed Loop is Active (CL Active or CL+Adapt)

Is HEGO1 voltage fixed between 0.40 - 0.60 volts?

Yes
- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on HEGO1 sensor signal circuit and 5Vtrn circuit between the ECM connector and HEGO1 connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms on both circuits?

Yes
- Using a DST, check the HEGO impedance feedback versus target

No
- Repair wiring harness circuit that was not < 5 ohms

No
- Repair wiring harness circuit that was not < 5 ohms

Is HEGO1 voltage fixed between 0.40 - 0.60 volts?

Yes
- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on HEGO1 sensor signal circuit and 5Vtrn circuit between the ECM connector and HEGO1 connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms on both circuits?

Yes
- Repair wiring harness circuit that was not < 5 ohms

No
- Repair wiring harness circuit that was not < 5 ohms

Is HEGO heater is not functional or sensor element is cracked
- Replace HEGO sensor

Does measured DC or voltage equal commanded DC or voltage displayed on DST?

Yes
- Replace ECM

No
- Replace HEGO sensor

No
- Replace HEGO sensor and retest

Is HEGO properly functioning?

Yes
- HEGO sensor was faulty
DTC 0140 - Heated Exhaust Gas Oxygen 3 (HEGO3) Sensor Circuit Open/Lazy
SPN - 3256; FMI - 5

- Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 3/Bank 1-After Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - HEGO cold longer than 120 seconds
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

This fault will set if the sensor element is cold, non-responsive, or inactive for 120 seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback. This fault should disable closed-loop when it is active and adaptive learn for the key-cycle.
DTC 0140 - Heated Exhaust Gas Oxygen 3 (HEGO3) Sensor Circuit Open/Lazy

- Engine Running
  - Warm engine to normal operating temperature (ECM must have been powered for > 5 minutes)
  - Using DST, ensure that Closed Loop is Active (CL Active or CL+Adapt)

Is HEGO3 voltage fixed between 0.40 - 0.60 volts?

- Key OFF
  - Disconnect wiring harness connector from ECM
  - Carefully remove the yellow lock from the connector
  - CAREFULLY check resistance on HEGO3 sensor signal circuit and 5Vrtn circuit between the ECM connector and HEGO3 connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms on both circuits?

- Using a DST, check the HEGO impedance feedback versus target

Is the resistance < 5 ohms on both circuits?

- Repair wiring harness circuit that was not < 5 ohms

Is the resistance < 5 ohms on both circuits?

- Replace HEGO sensor and retest

Does measured DC or voltage equal commanded DC or voltage displayed on DST?

- With the HEGO sensor connected to the wire harness, measure the heater control duty-cycle across heater + and - at sensor
  - Alternatively, with the HEGO sensor connected to the wire harness, measure the heater control voltage across heater + and - at sensor

- HEGO heater is not functional or sensor element is cracked
  - Replace HEGO sensor

- Replace ECM
  - HEGO sensor was faulty

- HEGO sensor was faulty

No

Yes

Yes

Yes

No

No

No

Yes

No
Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 2/Bank 2-Before Catalyst)

- **Check Condition** - Engine Running
- **Fault Condition** - HEGO cold longer than 120 seconds
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- **Emissions related fault**

The HEGO sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

This fault will set if the sensor element is cold, non-responsive, or inactive for 120 seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback. This fault should disable closed-loop when it is active and adaptive learn for the key-cycle.
Engine Running

- Warm engine to normal operating temperature (ECM must have been powered for > 5 minutes)
- Using DST, ensure that Closed Loop is Active (CL Active or CL+Adapt)

Is HEGO2 voltage fixed between 0.40 - 0.60 volts?

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on HEGO2 sensor signal circuit and 5Vrtn circuit between the ECM connector and HEGO2 connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms on both circuits?

No

- Repair wiring harness circuit that was not < 5 ohms

Yes

- Using a DST, check HEGO impedance feedback versus target

Is the resistance < 5 ohms on both circuits?

No

- Replace HEGO sensor and retest

Yes

- Repair wiring harness circuit that was not < 5 ohms

Does measured DC or voltage equal commanded DC or voltage displayed on DST?

No

- Replace ECM

Yes

- With the HEGO sensor connected to the wire harness, measure the heater control duty-cycle across heater + and - at sensor
- Alternatively, with the HEGO sensor connected to the wire harness, measure the heater control voltage across heater + and - at sensor

• HEGO heater is not functional or sensor element is cracked
• Replace HEGO sensor

Is HEGO properly functioning?

No

- HEGO sensor was faulty
DTC 0160 - Heated Exhaust Gas Oxygen 4 (HEGO4) Sensor Circuit Open/Lazy
SPN - 3266; FMI - 5

- Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 4/Bank 2-After Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - HEGO cold longer than 120 seconds
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes.

This fault will set if the sensor element is cold, non-responsive, or inactive for 120 seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback. This fault should disable closed-loop when it is active and adaptive learn for the key-cycle.
DTC 0160 - Heated Exhaust Gas Oxygen 4 (HEGO4) Sensor Circuit Open/Lazy

SPN - 3266; FMI - 5

- Engine Running
- Warm engine to normal operating temperature (ECM must have been powered for > 5 minutes)
- Using DST, ensure that Closed Loop is Active (CL Active or CL+Adapt)

Is HEGO4 voltage fixed between 0.40 - 0.60 volts?

Yes
- Key OFF
- Disconnect wiring harness connector from ECM
- CAREFULLY check resistance on HEGO4 sensor signal circuit and 5Vrh circuit between the ECM connector and HEGO4 connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

No
- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on HEGO4 sensor heater low-side circuit and between the ECM connector and HEGO4 connector. Also, check resistance on HEGO4 sensor heater high-side circuit and between the HEGO4 connector and power relay. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms on both circuits?

Yes
- Using a DST, check the HEGO impedance feedback versus target

No
- Repair wiring harness circuit that was not < 5 ohms

Is the resistance < 5 ohms on both circuits?

Yes
- Repair wiring harness circuit that was not < 5 ohms

No

Is HEGO properly functioning?

Yes
- HEGO heater is not functional or sensor element is cracked
- Replace HEGO sensor

No
- Does measured DC or voltage equal commanded DC or voltage displayed on DST?

Yes
- Replace ECM

No
- Replace HEGO sensor and retest

- With the HEGO sensor connected to the wire harness, measure the heater control duty-cycle across heater + and - at sensor
- Alternatively, with the HEGO sensor connected to the wire harness, measure the heater control voltage across heater + and - at sensor

- HEGO sensor was faulty
DTC 0171 - Adaptive-Learn Bank 1 High
SPN - 4237; FMI - 0

- Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - Bank 1 adaptive fuel multiplier higher than 30%
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

This fault sets if the Adaptive multiplier exceeds 30%, indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the fuel injection system, 3) a non-responsive HEGO sensor, and/or 3) an injector that is stuck closed. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.
Diagnostic Aids

- Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.
- Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- Injectors - System will be lean if an injector driver or driver circuit fails. The system will also be lean if an injector fails in a closed manner or is dirty.
- Fuel Pressure - System will be lean if fuel pressure is too low. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.
- Air in Fuel - If the fuel return hose/line is too close to the fuel supply pickup in the fuel tank, air may become entrapped in the pump or supply line causing a lean condition and driveability problems.
- Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the HEGO sensor causing a false lean condition.
- Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including oxygenated fuels.
- System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- If all tests are OK, replace the HEGO sensor with a known good part and retest.
DTC 0172 - Adaptive-Learn Bank 1 Low
SPN - 4237; FMI - 1

- Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - Bank 1 adaptive fuel multiplier lower than -30%
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.

Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

This fault sets if the Adaptive multiplier is lower than -30%, indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the fuel injection system, 2) a non-responsive HEGO sensor, and/or 3) an injector that is stuck open. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.
DTC 0172 - Adaptive-Learn Bank 1 Low
SPN - 4237; FMI - 1

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness

- Injectors - System will be rich if an injector driver or driver circuit fails shorted-to-ground. The system will also be rich if an injector fails in an open.

- Fuel Pressure - System will be rich if fuel pressure is too high. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.

- System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.

- If all tests are OK, replace the HEGO sensor with a known good part and retest
DTC 0174 - Adaptive-Learn Bank 2 High
SPN - 4239; FMI - 0

- Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 3/Bank 2-Before Catalyst)
- Check Condition - Engine Running
- Fault Condition - Bank 2 adaptive fuel multiplier higher than 30%
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

This fault sets if the Adaptive multiplier exceeds 30%, indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the fuel injection system, 3) a non-responsive HEGO sensor, and/or 3) an injector that is stuck closed. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.
DTC 0174 - Adaptive-Learn Bank 2 High
SPN - 4239; FMI - 0

Diagnostic Aids

- Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.
- Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- Injectors - System will be lean if an injector driver or driver circuit fails. The system will also be lean if an injector fails in a closed manner or is dirty.
- Fuel Pressure - System will be lean if fuel pressure is too low. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.
- Air in Fuel - If the fuel return hose/line is too close to the fuel supply pickup in the fuel tank, air may become entrapped in the pump or supply line causing a lean condition and driveability problems.
- Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the HEGO sensor causing a false lean condition.
- Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including oxygenated fuels.
- System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- If all tests are OK, replace the HEGO sensor with a known good part and retest.
Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 3/Bank 2-Before Catalyst)
• Check Condition - Engine Running
• Fault Condition - Bank 2 adaptive fuel multiplier lower than -30%
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
• Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

This fault sets if the Adaptive multiplier is lower than -30%, indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the fuel injection system, 2) a non-responsive HEGO sensor, and/or 3) an injector that is stuck open. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.
## Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Injectors** - System will be rich if an injector driver or driver circuit fails shorted-to-ground. The system will also be rich if an injector fails in an open.

- **Fuel Pressure** - System will be rich if fuel pressure is too high. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.

- **System Grounding** - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.

- If all tests are OK, replace the HEGO sensor with a known good part and retest.

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**DTC 0175 - Adaptive-Learn Bank 2 Low**

**SPN - 4239; FMI - 1**
DTC 0217 - ECT Higher Than Expected Stage 2
SPN - 110; FMI - 0

• Engine Coolant Temperature Sensor
• Check Condition - Engine Running
• Fault Condition - Engine Coolant Temperature reading greater than 210 degrees F when operating at a speed greater than 600 RPM
• Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.
• Non-emissions related fault

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. It is used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds 210 deg. F and engine RPM exceeds 600 RPM for the latch time this fault will set.
DTC 0217 - ECT Higher Than Expected Stage 2
SPN - 110; FMI - 0

Diagnostic Aids

- If the “ECT High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “ECT Higher Than Expected 1.”
- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking
- Ensure that there is no trapped air in the cooling path
- Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free
- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected
- Check that the thermostat is not stuck closed
- Check that the raw water pump/impeller is tact and that it is not restricted
DTC 0219 - RPM Higher Than Max Allowed Governed Speed
SPN - 515; FMI - 15

- Max Govern Speed Override - Crankshaft Position Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Engine speed greater than the max gov override speed as defined in the diagnostic calibration
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, reduce throttle to limit speed. Recommend closed loop and adaptive learn fueling correction remains active during fault.
- Non-emissions related fault

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage.

The throttle will be lowered in order to govern the engine to the speed set in the diagnostic calibration.
Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- Check mechanical operation of the throttle
- Check the engine intake for large air leaks downstream of the throttle body
DTC 0221 - TPS1 % Higher Than TPS2 %  
SPN - 51; FMI - 0

• Throttle Body-Throttle Position Sensor 1 & 2 (electronic throttle body only)  
• Check Condition - Key-On, Engine Cranking, or Running  
• Fault Condition - TPS1 higher than TPS2 by 20%  
• Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, shutdown engine  
• Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS1 % is higher than TPS2 % by 20%. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. During this active fault, an audible/visual alert device is activated and either an engine shutdown should be triggered or throttle control is set to use the higher of the two feedback signals for control in combination with a low rev limit and/or power derate.
DTC 0221 - TPS1 % Higher Than TPS2 %
SPN - 51; FMI - 0

- Key ON, Engine OFF
- Using DST, enable DBW Test Mode
- Slowly move the throttle handle while observing TPS1 and TPS2 %

Is TPS1 and TPS2 difference more than 20%?
Yes
No

Intermittent Problem

- Key OFF
- Disconnect TPS electrical connector
- Key ON, Engine OFF
- Using DST, enable DBW Test Mode

Is the voltage for both TPS1 and TPS2 < 0.100 volts?
Yes
No

- TPS (the one over 0.100 volts) is shorted to voltage
- Faulty ECM

- Faulty connection at TPS
- Faulty TPS

Does DST display both TPS1 and TPS2 voltages over 4.90 volts when each is connected to 5Vref?
Yes
No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- **CAREFULLY** check resistance on TPS1 and TPS2 signal circuits between the ECM connector and TPS connector. **NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.**

- TPS1 or TPS2 signal circuit shorted to ground
- Faulty connection at ECM
- Faulty ECM

Are both resistances < 5 ohms?
Yes
No

- Faulty wire harness

- Faulty connection at TPS
- Faulty TPS

- TPS (the one over 0.100 volts) is shorted to voltage
- Faulty ECM

- Key OFF
- Disconnect TPS electrical connector
DTC 0222 - TPS2 Signal Circuit Voltage Low
SPN - 3673; FMI - 4

- Throttle Body - Throttle Position Sensor 2
- **Check Condition** - Key On, Engine Cranking or Running
- **Fault Condition** - TPS2 sensor voltage lower than 0.20 volts
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, shutdown engine
- Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS2 voltage is lower than 0.20 volts at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by the TPS sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TPS circuit in the wire harness, or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.
DTC 0222 - TPS2 Signal Circuit Voltage Low
SPN - 3673; FMI - 4

• Key ON, Engine OFF
• Using DST, enable DBW Test Mode

Is TPS2 voltage low (<1.0 volt) at 0% TPS by design?

- No
- Yes

Does DST display TPS2 voltage < 0.2 volts with the throttle open?

- No
- Yes

Does DST display TPS2 voltage < 0.2 volts with the throttle closed?

- No
- Yes

Does TPS2 voltage ever fall below 0.2 volts?

- No
- Yes

Does TPS2 voltage ever fall below 0.2 volts?

- No
- Yes

Does DST display TPS2 voltage > 4.0 volts?

- No
- Yes

Is the resistance < 5 ohms?

- Yes
- No

• Faulty Harness

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on TPS2 signal circuit between the ECM connector and TPS connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

- Faulty TPS harness connection
- Faulty TPS

• Slowly move the throttle handle while observing TPS2 voltage

• Slowly release the throttle handle while observing TPS2 voltage

• Jumper 5Vref to TPS2 signal circuit at the TPS connector
• Key ON, Engine OFF

• Faulty Harness

• TPS2 signal circuit shorted to ground
• Faulty ECM connection
• Faulty ECM
• Faulty TPS

• Faulty Harness

• Key OFF
• Disconnect TPS electrical connector
• Throttle Body - Throttle Position Sensor 2
• Check Condition - Key On, Engine Cranking or Running
• Fault Condition - TPS2 sensor voltage higher than 4.80 volts
• Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, shutdown engine
• Non-emissions related fault

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses a variable resistor and voltage divider circuit to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

This fault will set if TPS2 voltage is higher than 4.80 volts at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by a short-to-power of the TPS circuit in the wire harness or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.
DTC 0223 - TPS2 Signal Circuit Voltage High
SPN - 3673; FMI - 3

- Key ON, Engine OFF
- Using DST, enable DBW Test Mode

Is TPS2 voltage low (<1.0 volt) at 0% TPS by design?

Yes

- Key OFF
- Disconnect TPS electrical connector
  - Key ON, Engine OFF

Does DST display TPS2 voltage > 4.80 volts with the throttle closed?

Yes

- Key OFF
- Disconnect TPS electrical connector
  - Key ON, Engine OFF

Does DST display TPS2 voltage > 4.80 volts with the throttle open?

No

- Slowly move the throttle handle while observing TPS2 voltage

Does the test light illuminate?

Yes

- Faulty TPS connection
  - Faulty TPS

No

- Open sensor ground circuit
  - Faulty ECM

Does DST display TPS2 voltage > 4.80 volts with the throttle open?

Yes

- Slowly release the throttle handle while observing TPS2 voltage

Does TPS2 voltage ever exceed 4.80 volts?

No

- Intermittent Problem

Yes

- Slowly release the throttle handle while observing TPS2 voltage

Does TPS2 voltage ever exceed 4.80 volts?

No

- Does DST display TPS2 voltage < 0.20 volts?

No

- Slowly release the throttle handle while observing TPS2 voltage

Does TPS2 voltage ever exceed 4.80 volts?

No

- Probe TPS2 sensor ground circuit at harness connector with test light connected to battery voltage

Does DST display TPS2 voltage < 0.20 volts?

Yes

- TPS2 signal circuit shorted to voltage
  - Faulty ECM
DTC 0261 - Injector Driver #1 Open / Short to Ground
SPN - 651; FMI - 5

- Injector #1 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #1.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
**DTC 0261 - Injector Driver #1 Open / Short to Ground**

**SPN - 651; FMI - 5**

- **Engine Running**
  - **Clear DTC's**
  - **Does DTC 0261 reset with engine idling?**
    - **Yes**
      - **Key OFF**
        - Disconnect Injector #1 (cylinder 1) electrical connector
        - Using a DMM, measure the resistance across the injector coil
    - **No**
      - **Intermittent Problem**

- **Key OFF**
  - **Disconnect wiring harness connector from ECM**
  - **Carefully remove the yellow lock from the connector**
  - **CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.**
  - **Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)**
  - **Does either measurement indicate a resistance < 5 ohms?**
    - **Yes**
      - **Key OFF**
        - Disconnect wiring harness connector from ECM
        - Carefully remove the yellow lock from the connector
        - **CAREFULLY** check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.
    - **No**
      - **Faulty ECM**

- **Does DMM indicate resistance < 5 ohms?**
  - **Yes**
    - **Faulty harness; short to ground**
  - **No**
    - **Faulty ECM**

- **Replace faulty injector**

- **Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)**

- **Engine Running**
  - **Is resistance between 11-14 ohms?**
    - **Yes**
      - **Replace faulty injector**
    - **No**
      - **Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)**
      - **Does either measurement indicate a resistance < 5 ohms?**
        - **Yes**
          - **Faulty harness; open circuit**
        - **No**
          - **Faulty ECM**
DTC 0262 - Injector Driver #1 Short to Power
SPN - 651; FMI - 6

• Injector #1 Coil or Driver Short-to-Power
• **Check Condition** - Key-On, Engine Running
• **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
• **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
• Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #1.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0262 - Injector Driver #1 Short to Power
SPN - 651; FMI - 6

- Engine Running
- Clear DTC's

Does DTC 0262 reset with engine idling?

- Yes
- Key OFF
- Disconnect Injector #1 (cylinder 1) electrical connector
- Using a DMM, measure the resistance across the injector coil

- No
- Intermittent Problem

Is resistance between 11-14 ohms?

- Yes
- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

- No
- Replace faulty injector

Does measurement indicate a resistance < 5 ohms?

- Yes
- Disconnect ECM connector
- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

- No
- Faulty harness; short to power
- Faulty ECM

- Replace injector and retest
DTC 0264 - Injector Driver #2 Open / Short to Ground
SPN - 652; FMI - 5

- Injector #2 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #2.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0264 - Injector Driver #2 Open / Short to Ground
SPN - 652; FMI - 5

- Engine Running
- Clear DTC's

Does DTC 0264 reset with engine idling?
  Yes
  Key OFF
  Disconnect Injector #2 (cylinder 2) electrical connector
  Using a DMM, measure the resistance across the injector coil

  Is resistance between 11-14 ohms?
    Yes
    Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)
    Does either measurement indicate a resistance < 5 ohms?
      Yes
        • Faulty harness; short to ground
      No
        • Replace faulty injector

    No
    • Replace faulty injector

  No
  • Replace faulty injector

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

  Does DMM indicate resistance < 5 ohms?
    Yes
      • Poor injector connection
      • Poor ECM connection
      • Faulty ECM
    No
      Faulty harness; open circuit

- Intermittent Problem
- Disconnect Injector #2 (cylinder 2) electrical connector
- Using a DMM, measure the resistance across the injector coil

- Is resistance between 11-14 ohms?
  Yes
  • Replace faulty injector

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

  Does DMM indicate resistance < 5 ohms?
    Yes
      • Faulty harness; short to ground
    No
      • Faulty ECM
DTC 0265 - Injector Driver #2 Short to Power
SPN - 652; FMI - 6

- Injector #2 Coil or Driver Short-to-Power
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #2.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0265 - Injector Driver #2 Short to Power
SPN - 652; FMI - 6

- Engine Running
- Clear DTC’s

Does DTC 0265 reset with engine idling?
- Yes
- No

Intermittent Problem

- Key OFF
- Disconnect Injector #2 (cylinder 2) electrical connector
- Using a DMM, measure the resistance across the injector coil

Is resistance between 11-14 ohms?
- Yes
- No

- Replace faulty injector

- Disconnect ECM connector

- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

Does measurement indicate a resistance < 5 ohms?
- Yes
- No

- Replace injector and retest

- Faulty harness; short to power

- Faulty ECM
DTC 0267 - Injector Driver #3
SPN - 653; FMI - 5

- Injector #3 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #3.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0267 - Injector Driver #3
SPN - 653; FMI - 5

- Engine Running
  - Clear DTC's
    - Does DTC 0267 reset with engine idling?
      - Yes
        - Key OFF
        - Disconnect Injector #3 (cylinder 3) electrical connector
        - Using a DMM, measure the resistance across the injector coil
      - No
        - Intermittent Problem

- Key OFF
  - Disconnect Injector #3 (cylinder 3) electrical connector
  - Using a DMM, measure the resistance across the injector coil

- Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

- Is resistance between 11-14 ohms?
  - Yes
    - Does either measurement indicate a resistance < 5 ohms?
      - Yes
        - Faulty harness; short to ground
      - No
        - Faulty ECM
  - No

- Replace faulty injector

- Faulty harness; short to ground
  - Yes
    - Disconnect wiring harness connector from ECM
    - Carefully remove the yellow lock from the connector
    - CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. **NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.**
  - No

- Faulty ECM

- Poor injector connection
  - Poor ECM connection
  - Faulty ECM

- Does either measurement indicate a resistance < 5 ohms?
  - Yes
  - No

- Faulty ECM

- Faulty harness; open circuit
DTC 0268 - Injector Driver #3 Short to Power
SPN - 653; FMI - 6

- Injector #3 Coil or Driver Short-to-Power
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #3.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0268 - Injector Driver #3 Short to Power
SPN - 653; FMI - 6

- Engine Running
- Clear DTC's

Does DTC 0268 reset with engine idling?

Yes
- Key OFF
- Disconnect Injector #3 (cylinder 3) electrical connector
- Using a DMM, measure the resistance across the injector coil

No
Intermittent Problem

Is resistance between 11-14 ohms?

Yes
- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

No
- Replace faulty injector

Does measurement indicate a resistance < 5 ohms?

Yes
- Disconnect ECM connector
- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

No
- Replace injector and retest

- Faulty harness; short to power

- Faulty ECM
DTC 0270 - Injector Driver #4 Open / Short to Ground
SPN - 654; FMI - 5

- Injector #4 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #4.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
**DTC 0270 - Injector Driver #4 Open / Short to Ground**

**SPN - 654; FMI - 5**

1. **Does DTC 0270 reset with engine idling?**
   - **Yes**
     - Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector).
     - Does either measurement indicate a resistance < 5 ohms?
       - **Yes**
         - Faulty harness; short to ground
       - **No**
         - Faulty ECM
   - **No**
     - Intermittent Problem
     - Key OFF
     - Disconnect injector #4 (cylinder 4) electrical connector
     - Using a DMM, measure the resistance across the injector coil
     - Is resistance between 11-14 ohms?
       - **Yes**
         - Replace faulty injector
       - **No**
         - Faulty ECM

2. **Engine Running**
   - Is resistance between 11-14 ohms?
     - **Yes**
     - Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector).
     - Does either measurement indicate a resistance < 5 ohms?
       - **Yes**
         - Faulty harness; short to ground
       - **No**
         - Faulty ECM
     - **No**
       - Measure resistance across the injector coil
       - **Key OFF**
       - **Remove faulty injector**

3. **Key OFF**
   - **Remove faulty injector**
   - **Does DMM indicate resistance < 5 ohms?**
     - **Yes**
     - **Faulty ECM**
     - **No**
     - **Faulty harness; open circuit**

4. **Intermittent Problem**
   - **Clear DTC’s**
   - **Does DTC 0270 reset with engine idling?**
     - **Yes**
       - Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector).
       - Does either measurement indicate a resistance < 5 ohms?
         - **Yes**
           - Faulty harness; short to ground
         - **No**
           - Faulty ECM
     - **No**
       - Key OFF
       - Disconnect injector #4 (cylinder 4) electrical connector
       - Using a DMM, measure the resistance across the injector coil
       - **Key OFF**
       - **Remove faulty injector**

5. **Does DMM indicate resistance < 5 ohms?**
   - **Yes**
     - **Faulty ECM**
   - **No**
     - **Faulty harness; open circuit**

**NOTE:** DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.
**DTC 0271 - Injector Driver #4 Short to Power**  
*SPN - 654; FMI - 6*

- **Injector #4 Coil or Driver Short-to-Power**
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- **Emissions-related fault**

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #4.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0271 - Injector Driver #4 Short to Power
SPN - 654; FMI - 6

- Engine Running
- Clear DTC's

- Key OFF
  - Disconnect Injector #4 (cylinder 4) electrical connector
  - Using a DMM, measure the resistance across the injector coil
- Does DTC 0271 reset with engine idling?
  - Yes
  - Intermittent Problem
  - No

- DOES DTC 0271 reset with engine idling?
  - Yes
  - Is resistance between 11-14 ohms?
    - Yes
    - Replace faulty injector
    - No
    - Replace faulty injector
  - No
    - Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)
    - Yes
      - Does measurement indicate a resistance < 5 ohms?
        - Yes
          - Faulty harness; short to power
        - No
          - Faulty ECM
    - No
      - Replace injector and retest

- Key OFF
- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)
- Does measurement indicate a resistance < 5 ohms?
DTC 0273 - Injector Driver #5 Open / Short to Ground
SPN - 655; FMI - 5

- Injector #5 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #5.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0273 - Injector Driver #5 Open / Short to Ground  
SPN - 655; FMI - 5

- Engine Running
- Clear DTC’s

Does DTC 0273 reset with engine idling?  
Yes

Key OFF
- Disconnect Injector #5 (cylinder 5) electrical connector
- Using a DMM, measure the resistance across the injector coil

Is resistance between 11-14 ohms?  
Yes

Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

Does either measurement indicate a resistance < 5 ohms?  
Yes

- Replace faulty injector

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Faulty harness; short to ground  
Yes

- Faulty ECM

No

Faulty ECM

- Poor injector connection
- Poor ECM connection
- Faulty ECM

Does DMM indicate resistance < 5 ohms?  
Yes

No

- Faulty harness; open circuit
DTC 0274 - Injector Driver #5 Short to Power
SPN - 655; FMI - 6

- Injector #5 Coil or Driver Short-to-Power
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #5.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0274 - Injector Driver #5 Short to Power
SPN - 655; FMI - 6

- Engine Running
- Clear DTC's

Does DTC 0274 reset with engine idling? Yes

- Key OFF
- Disconnect Injector #5 (cylinder 5) electrical connector
- Using a DMM, measure the resistance across the injector coil

Intermittent Problem

- Engine Running

Is resistance between 11-14 ohms? Yes

- Replace faulty injector

No

- Disconnect ECM connector

Does measurement indicate a resistance < 5 ohms? Yes

- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

No

- Faulty harness; short to power

Does measurement indicate a resistance < 5 ohms? Yes

- Replace injector and retest

No

- Faulty ECM
DTC 0276 - Injector Driver #6 Open / Short to Ground
SPN - 656; FMI - 5

- Injector #6 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #6.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0276 - Injector Driver #6 Open / Short to Ground
SPN - 656; FMI - 5

- Engine Running
- Clear DTC's

Does DTC 0276 reset with engine idling?

Yes

- Key OFF
- Disconnect Injector #6 (cylinder 6) electrical connector
- Using a DMM, measure the resistance across the injector coil

Is resistance between 11-14 ohms?

Yes

- Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

No

- Replace faulty injector

No

Intermittent Problem

- Key OFF
- Disconnect Injector #6 (cylinder 6) electrical connector
- Using a DMM, measure the resistance across the injector coil

Does DTC 0276 reset with engine idling?

No

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Does either measurement indicate a resistance < 5 ohms?

Yes

- Faulty harness; short to ground
- Faulty ECM

No

- Faulty ECM connection
- Poor ECM connection
- Faulty ECM

Does DMM indicate resistance < 5 ohms?

Yes

- Faulty ECM connection
- Poor ECM connection
- Faulty ECM

No

- Faulty harness; open circuit
**DTC 0277 - Injector Driver #6 Short to Power**  
**SPN - 656; FMI - 6**

- **Injector #6 Coil or Driver Short-to-Power**
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- **Emissions-related fault**

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #6.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0277 - Injector Driver #6 Short to Power
SPN - 656; FMI - 6

- Engine Running
- Clear DTC's

Does DTC 0277 reset with engine idling?
Yes

- Key OFF
  - Disconnect Injector #6 (cylinder 6) electrical connector
  - Using a DMM, measure the resistance across the injector coil

- Is resistance between 11-14 ohms?
  Yes
  - Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)
  - Does measurement indicate a resistance < 5 ohms?
    Yes
      - Replace injector and retest
    No
      - Faulty ECM
  No
  - Replace faulty injector

- No
  - Intermittent Problem

- Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)
- Does measurement indicate a resistance < 5 ohms?
  Yes
  - Replace injector and retest
  No
  - Faulty harness; short to power
DTC 0279 - Injector Driver #7 Open / Short to Ground
SPN - 657; FMI - 5

- Injector #7 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #7.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
• Clear DTC's
• Does DTC 0279 reset with engine idling?

Yes
• Key OFF
• Disconnect Injector #7 (cylinder 7) electrical connector
• Using a DMM, measure the resistance across the injector coil

No
• Intermittent Problem

Is resistance between 11-14 ohms?

Yes
• Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

No
• Replace faulty injector

Does either measurement indicate a resistance < 5 ohms?

Yes
• Faulty harness; short to ground

No
• Faulty ECM

• Faulty harness; open circuit
DTC 0280 - Injector Driver #7 Short to Power
SPN - 657; FMI - 6

- Injector #7 Coil or Driver Short-to-Power
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #7.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0280 - Injector Driver #7 Short to Power
SPN - 657; FMI - 6

• Engine Running
• Clear DTC's

Does DTC 0280 reset with engine idling?

Yes
• Key OFF
• Disconnect Injector #7 (cylinder 7) electrical connector
• Using a DMM, measure the resistance across the injector coil

No
• Replace faulty injector

Intermittent Problem

Is resistance between 11-14 ohms?

Yes
• Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

No
• Replace injector and retest

Faulty harness; short to power

Does measurement indicate a resistance < 5 ohms?

Yes
• Disconnect ECM connector

No
• Faulty ECM

Faulty harness; short to power
DTC 0282 - Injector Driver #8 Open / Short to Ground
SPN - 658; FMI - 5

- Injector #8 Coil or Driver Open Circuit or Short-to-Ground
- **Check Condition** - Key-On, Engine Running
- **Fault Condition** - Battery voltage at ECM greater than 9.0 volts and injector low-side less than 4.0 volts for 10 injector firings.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #8.

This fault will set if the ECM detects low feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the off-state and battery voltage is greater than 9.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0282 - Injector Driver #8 Open / Short to Ground
SPN - 658; FMI - 5

- Engine Running
  • Clear DTC’s

- Does DTC 0282 reset with engine idling?
  Yes
  • Key OFF
  • Disconnect Injector #8 (cylinder 8) electrical connector
  • Using a DMM, measure the resistance across the injector coil

  Is resistance between 11-14 ohms?
  Yes
  • Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

  Does either measurement indicate a resistance < 5 ohms?
  Yes
  • Key OFF
  • Disconnect wiring harness connector from ECM
  • Carefully remove the yellow lock from the connector
  • CAREFULLY check resistance on injector low-side circuit between the ECM connector and injector connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

  Does DMM indicate resistance < 5 ohms?
  Yes
  • Faulty harness; short to ground
  • Faulty ECM

  No
  • Replace faulty injector

  • Disconnect ECM connector

  • Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

  Does either measurement indicate a resistance < 5 ohms?
  Yes
  • Faulty harness; open circuit

  No
  • Poor injector connection
  • Poor ECM connection
  • Faulty ECM

- No
  • Intermittent Problem

  • Disconnect Injector #8 (cylinder 8) electrical connector
  • Using a DMM, measure the resistance across the injector coil

  Is resistance between 11-14 ohms?
  No
  • Replace faulty injector

  • Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

  Does either measurement indicate a resistance < 5 ohms?
  Yes
  • Faulty harness; short to ground
  • Faulty ECM

  No
  • Replace faulty injector

  • Measure resistance from the injector low-side wire in the injector connector to battery ground and then to sensor ground (can be accessed through another sensor connector)

  Does either measurement indicate a resistance < 5 ohms?
  Yes
  • Faulty harness; open circuit

  No
  • Replace faulty injector
DTC 0283 - Injector Driver #8 Short to Power
SPN - 658; FMI - 6

- Injector #8 Coil or Driver Short-to-Power
- Check Condition - Key-On, Engine Running
- Fault Condition - Battery voltage at ECM less than 16.0 volts and injector low-side greater than 4.0 volts for 10 injector firings.
- Corrective Action(s) - Illuminate MIL and/or sound audible warning, disable adaptive learn and closed-loop fueling correction for key-cycle.
- Emissions-related fault

The fuel injector is an electronically controlled valve and nozzle that is controlled to deliver a precise quantity of fuel to a cylinder (Sequential Port Fuel Injection). This fault sets for the injector on cylinder #8.

This fault will set if the ECM detects higher than expected feedback voltage (4.0 VDC) on the injector coil while the injector drive circuit is in the on-state and battery voltage is less than 16.0 volts for 10 injector firings as defined in the diagnostic calibration.
DTC 0283 - Injector Driver #8 Short to Power
SPN - 658; FMI - 6

- Engine Running
- Clear DTC's

Does DTC 0283 reset with engine idling?
    Yes
    - Key OFF
    - Disconnect Injector #8 (cylinder 8) electrical connector
    - Using a DMM, measure the resistance across the injector coil
    - Is resistance between 11-14 ohms?
        Yes
        - Replace faulty injector
        No
        - Measure resistance from the injector low-side wire in the injector connector to all voltage sources in the harness (Vbat, Vsw, Relay power, 5Vref, INJ High-side)

    No

- Intermittent Problem

- Replace injector and retest
- Faulty harness; short to power
- Faulty ECM

- ECM0708

125
DTC 0301 - Emissions / Catalyst Damage Misfire Detected Cylinder #1  
SPN - 1323; FMI - 31

6.0L

• Cylinder #1 Misfire Detected - Emissions/Catalyst Damaging  
• Check Condition - Key On, Engine Running  
• Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage  
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.  
• Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
Cylinder #2 Misfire Detected - Emissions/Catalyst Damaging

Check Condition - Key On, Engine Running

Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage

Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.

Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:

1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** - Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** - Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** - Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** - Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** - Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0303 - Emissions / Catalyst Damage Misfire Detected Cylinder #3
SPN - 1325; FMI - 31

- Cylinder #3 Misfire Detected - Emissions/Catalyst Damaging
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that bank's aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** – Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0304 - Emissions / Catalyst Damage Misfire Detected Cylinder #4
SPN - 1326; FMI - 31

- Cylinder #4 Misfire Detected - Emissions/Catalyst Damaging
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 0304 - Emissions / Catalyst Damage Misfire Detected Cylinder #4
SPN - 1326; FMI - 31

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
Cylinder #5 Misfire Detected - Emissions/Catalyst Damaging
- **Check Condition** - Key On, Engine Running
- **Fault Condition** - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- **Emissions related fault**

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

**Diagnostic Aids**

*NOTE: If any other DTCs are present, diagnose those first.*

- **Oil Level** – Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0306 - Emissions / Catalyst Damage Misfire Detected Cylinder #6
SPN - 1328; FMI - 31

- Cylinder #6 Misfire Detected - Emissions/Catalyst Damaging
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) or intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0307 - Emissions / Catalyst Damage Misfire Detected Cylinder #7
SPN - 1329; FMI - 31

- Cylinder #7 Misfire Detected - Emissions/Catalyst Damaging
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level**: Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)**: Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)**: Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure**: Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check**: Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak**: Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0308 - Emissions / Catalyst Damage Misfire Detected Cylinder #8
SPN - 1330; FMI - 31

- Cylinder #8 Misfire Detected - Emissions/Catalyst Damaging
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECM is capable of detecting combustion misfire for certain crank-cam software modules. The ECM continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The ECM has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the emissions/catalyst misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

**Diagnostic Aids**

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 0326 - Knock 1 Excessive or Erratic Signal  
SPN - 731; FMI - 2

- Knock sensor #1  
- Check Condition - Key On, Engine On  
- Fault Condition - Knock sensor 1 indicates an excessive signal level  
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, possibly power derate the engine, and retard spark to Faulted KNK Retard level to protect engine from possible damage due to unsensed detonation  
- Emissions related fault

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and “learn” between spark tables based on fuel quality.

This fault sets if the signal from knock sensor 1 is higher than 4.50 volts and MAP less than 8.00 psia. If this fault sets, spark is lowered by the amount defined in calibration for Faulted KNK Retard.
Does DST indicate DTC 326 as Active?

- Yes
  - Replace faulty sensor

- No
  - Engine Running
    - Operate engine at the condition that generated the fault as indicated in fault snapshot
    - Verify that DTC 326 is active
  
  - Disconnect knock sensor 1 electrical connector
  
  - Operate engine at the condition that generated the fault as indicated in fault snapshot

  Does DST indicate DTC 326 as Active?

  - Yes
  
  - Disconnect ECM connector
  
  - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
    - No
      - Possible faulty sensor
      - Intermittent fault
    
    - Yes
      
      - Faulty wire harness
      
      - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
        - Yes
          - Faulty wire harness
        
        - No
          - Possible faulty ECM
    
    - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
      
      - No
        
        - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
          - Yes
            
            - Faulty wire harness
          
          - No
            
            - Possible faulty ECM

- No
  - Key ON, Engine OFF
    
    - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
      - Yes
        
        - Faulty wire harness
      
      - No
        
        - Possible faulty sensor
  
  - Intermittent fault
  
  - Faulty wire harness
  
  - Using a DMM, is the voltage potential between Knock 1 + and Vbat > 80% of Vbat?
    
    - Yes
      
      - Faulty wire harness
    
    - No
      
      - Possible faulty ECM
DTC 0327 - Knock 1 Sensor Circuit Open
SPN - 731; FMI - 4

• Knock sensor #1
• Check Condition - Key On, Engine On
• Fault Condition - Knock sensor 1 signal low while engine speed is greater than 3000 RPM and MAP is greater than 10.00 psia as defined in the diagnostic calibration
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, possibly power derate the engine, and retard spark to Faulted KNK Retard level to protect engine from possible damage due to inability to sense detonation
• Emissions related fault

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and “learn” between spark tables based on fuel quality.

This fault sets if the signal from knock sensor 1 is lower than expected for higher speed and load operation as defined in calibration. If this fault sets, spark is lowered by the amount defined in calibration for Faulted KNK Retard.
DTC 0327 - Knock 1 Sensor Circuit Open
SPN - 731; FMI - 4

- Engine Running

- Using a DST, clear DTC's
- Operate engine at minimum of 3000 RPM and greater than 10.0 psia MAP

Does DTC 327 reset?

- Yes
  - Key Off
  - Disconnect knock sensor electrical connector

- No
  - Intermittent Fault

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- CAREFULLY check resistance on knock 1 sensor + circuit between the ECM connector and knock 1 sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

- Does DMM indicate resistance < 5.0 ohms?
  - No
    - Faulty harness, open circuit
  - Yes
    - Check resistance between knock 1 + and ground; also 5Vttn (sensor ground)

- Does DMM indicate resistance < 5.0 ohms?
  - Yes
    - Faulty harness, short to ground
  - No
    - Inspect knock wiring in harness

- Is wiring properly twisted?
  - No
    - Faulty harness
  - Yes
    - Replace faulty sensor and retest
    - Faulty ECM
DTC 0331 - Knock 2 Excessive or Erratic Signal
SPN - 520197; FMI - 2

- Knock sensor #2
- **Check Condition** - Key On, Engine On
- **Fault Condition** - Knock sensor 2 indicates an excessive signal level
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, possibly power derate the engine, and retard spark to Faulted KNK Retard level to protect engine from possible damage due to unsensed detonation
- Emissions related fault

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and “learn” between spark tables based on fuel quality.

This fault sets if the signal from knock sensor 2 is higher than 4.50 volts and MAP less than 8.00 psia. If this fault sets, spark is lowered by the amount defined in calibration for Faulted KNK Retard.
DTC 0331 - Knock 2 Excessive or Erratic Signal
SPN - 520197; FMI - 2

• Engine Running
  • Operate engine at the condition that generated the fault as indicated in fault snapshot
  • Verify that DTC 331 is active

• Key ON, Engine OFF
  Using a DMM, is the voltage potential between Knock 2 + and Vbat > 80% of Vbat?

  No
  • Possible faulty sensor
  • Intermittent fault

  Yes

  Using a DMM, is the voltage potential between Knock 2 + and Vbat > 80% of Vbat?

  Yes
  • Faulty wire harness

  No
  • Possible faulty ECM

• Disconnect knock sensor 2 electrical connector

• Engine Running
  • Operate engine at the condition that generated the fault as indicated in fault snapshot

• Key ON, Engine OFF
  Using a DMM, is the voltage potential between Knock 2 + and Vbat > 80% of Vbat?

  No
  • Replace faulty sensor

  Yes

  • Disconnect ECM connector

• Key ON, Engine OFF
  Using a DMM, is the voltage potential between Knock 2 + and Vbat > 80% of Vbat?

  Yes
  • Faulty wire harness

  No
  • Possible faulty ECM
DTC 0332 - Knock 2 Sensor Circuit Open  
SPN - 520197; FMI - 4

- Knock sensor #2
- Check Condition - Key On, Engine On
- Fault Condition - Knock sensor 2 signal low while engine speed is greater than 3000 RPM and MAP is greater than 10.00 psia as defined in the diagnostic calibration
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, possibly power derate the engine, and retard spark to Faulted KNK Retard level to protect engine from possible damage due to inability to sense detonation
- Emissions related fault

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and “learn” between spark tables based on fuel quality.

This fault sets if the signal from knock sensor 2 is lower than expected for higher speed and load operation as defined in calibration. If this fault sets, spark is lowered by the amount defined in calibration for Faulted KNK Retard.
DTC 0332 - Knock 2 Sensor Circuit Open
SPN - 520197; FMI - 4

• Engine Running
  • Using a DST, clear DTC's
  • Operate engine at minimum of 3000 RPM and greater than 10.0 psia MAP

Does DTC 332 reset?
Yes
  • Key Off
  • Disconnect knock sensor electrical connector

No
  • Intermittent Fault

• Key Off
  • Disconnect wiring harness connector from ECM
  • Carefully remove the yellow lock from the connector
  • CAREFULLY check resistance on knock 2 sensor + circuit between the ECM connector and knock 2 sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Does DMM indicate resistance < 5.0 ohms?
No
  • Faulty harness, open circuit

Yes
  • Check resistance between knock 2 + and ground; also 5Vrtn (sensor ground)

Does DMM indicate resistance < 5.0 ohms?
Yes
  • Faulty harness, short to ground

No
  • Inspect knock wiring in harness

Is wiring properly twisted?
No
  • Faulty harness

Yes
  • Replace faulty sensor and retest
  • Faulty ECM
DTC 0336 - Crank Sensor Input Signal Noise
SPN - 636; FMI - 2

- Crankshaft Position sensor
- **Check Condition** - Key On, Engine On
- **Fault Condition** - Electrical noise or irregular crank pattern detected causing 1 number of crank re-synchronization events as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp and disable adaptive fueling correction for remainder of key-cycle.
- Emissions related fault

The crankshaft position sensor is a magnetic sensor installed in the engine block adjacent to a “coded” trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The ECM must see a valid crankshaft position signal while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to trigger wheel), or an irregular crank pattern is detected causing the ECM to resynchronize x times for y ms or longer as defined in the diagnostic calibration, this fault will set. Irregular crank patterns can be detected by the ECM due to electrical noise, poor machining of trigger wheel, or trigger wheel runout and/or gear lash.
Does DTC 336 reset?

- Engine Running

- Operate engine at the condition that generated the fault as indicated in fault snapshot

- Intermittent Fault

Does DTC 336 reset?

- Check wiring and electrical connections between crankshaft position sensor and ECM

- Check for poor system ground
  - Faulty crankshaft position sensor
  - Faulty ECM

Is the wiring OK?

- Repair Harness
DTC 0337 - Loss of Crankshaft Input Signal
SPN - 636; FMI - 4

- Crankshaft Position sensor
- **Check Condition** - Key On, Engine On, Engine Cranking
- **Fault Condition** - Loss of crankshaft position signal while valid camshaft position signals continue for 3
  number of cam pulses as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Emissions related fault

The crankshaft position sensor is a magnetic sensor installed in the engine block adjacent to a “coded”
trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine
 crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed.
Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel
injection, and throttle governing systems for precise engine control.

The ECM must see a valid crankshaft position signal while running. If no signal is present while 3 cam
pulses continue the fault will set. The engine typically stalls or dies as a result of this fault condition due to
the lack of crankshaft speed input resulting in the inability to control ignition timing.

**Diagnostic Aids**

- Check for poor connection in harness. Inspect the harness connectors for backed out terminals,
  improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire
  connection.
- Crankshaft reluctor wheel damaged or improper installation.
- Excessive air gap between the CKP sensor and the reluctor.
- Excessive crankshaft end play.
DTC 0337 - Loss of Crankshaft Input Signal
SPN - 636; FMI - 4

Does DTC 0337 reset with engine cranking or idling?

No

Intermittent Problem. Refer to Diagnostic Aids.

Yes

Using a DST, Clear DTC's

Does DTC 0337 reset with engine cranking or idling?

No

Yes

• Ignition ON, Engine OFF
  • Disconnect CKP Sensor electrical connector.
  • Using a DMM connected to a known good ground, check for voltage at the CKP sensor connector terminal “A” (5.0/5.7L) or terminal “C” (6.0/6.2L).
  • Is voltage near 5 volts?

No

Yes

• Ignition OFF
  • Disconnect ECM electrical connector.
  • Using a DMM, check for continuity between the CKP sensor connector terminal “B” (5.0/5.7L) or terminal “A” (6.0/6.2L) and ECM terminal ‘21’.
  • Is there continuity?

No

Yes

• Using a DMM, check for continuity between the CKP sensor connector terminal “B” and ECM terminal ‘22’.
  • Is there continuity?

No

Yes

• Inspect the CKP sensor connector terminals for damage, corrosion or contamination.
  • Was a problem found?

No

Yes

• Inspect the ECM connector terminals 20, 21 and 22 for damage, corrosion or contamination.
  • Was a problem found?

No

Yes

• Using a DMM, check the resistance across the CKP sensor terminals “B” and “C” (5.0/5.7L) or “A” (6.0/6.2L).
  • Was a problem found?

No

Replace ECM.

Repair ECM ground circuit as necessary.

Repair CKP sensor 5 volt circuit as necessary.

Repair CKP sensor ground circuit as necessary.

Repair CKP sensor signal circuit as necessary.

Repair or replace CKP sensor connector or wiring as necessary.

Repair or replace ECM sensor connector or wiring as necessary.

Replace CKP sensor.
DTC 0341 - Camshaft Sensor Input Signal Noise
SPN - 723; FMI - 2

- Camshaft Position sensor
- **Check Condition** - Key On, Engine On
- **Fault Condition** - Electrical noise or irregular cam pattern detected causing 1 number of cam re-synchronization events as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp and disable adaptive fueling correction for remainder of key-cycle.
- Emissions related fault

The camshaft position sensor is a magnetic sensor installed in the engine block or valve train adjacent to a "coded" trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to trigger wheel), or an irregular cam pattern is detected causing the ECM to resynchronize x times for y ms or longer as defined in the diagnostic calibration, this fault will set. Irregular cam patterns can be detected by the ECM due to electrical noise, poor machining of trigger wheel, or trigger wheel runout and/or gear lash. Normally the engine will continue to run if equipped with a waste-spark or distributor ignition system. In some instances this fault can cause rough engine operation and can cause the engine to stall or die if equipped with coil-on-plug ignition engines.
DTC 0341 - Camshaft Sensor Input Signal Noise
SPN - 723; FMI - 2

• Engine Running

• Operate engine at the condition that generated the fault as indicated in fault snapshot

Does DTC 341 reset?

Yes

• Check wiring and electrical connections between camshaft position sensor and ECM

No

• Intermittent Fault

Is the wiring OK?

No

• Repair Harness

Yes

• Check for poor system ground
  • Faulty camshaft position sensor
  • Faulty ECM
DTC 0342 - Loss of Camshaft Input Signal  
SPN - 723; FMI - 4

- Camshaft Position sensor
- **Check Condition** - Key On, Engine On
- **Fault Condition** - Loss of camshaft position signal while valid crankshaft position signals continue for 2.0 number of engine cycles while operating at an engine speed > than 100 RPM as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for the remainder of the key-cycle
- Emissions related fault

The camshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block or valve train adjacent to a “coded” trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. This fault will set if valid crankshaft position data is received for 2.0 number of engine cycles while engine speed is greater than 100 RPM and no camshaft signal is received. Normally the engine will continue to run if equipped with a waste-spark or distributor ignition system. In some instances this fault can cause rough engine operation and can cause the engine to stall or die if equipped with coil-on-plug ignition engines.
DTC 0342 - Loss of Camshaft Input Signal
SPN - 723; FMI - 4

Diagnostic Aids

- Check that camshaft position sensor is securely connected to harness
- Check that camshaft position sensor is securely installed into engine block
- Check camshaft position sensor circuit wiring for open circuit
**DTC 0420 - Catalyst Inactive on Bank 1**
**SPN - 3050; FMI - 11**

- Bank 1 Catalyst, Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 3-After Catalyst)
- Check Condition- Engine Running
- Fault Condition- Bank 1 catalyst inactive on gasoline
- Corrective Action(s)- Illuminate MIL and/or sound audible warning.
- Emissions related fault

A catalyst or catalytic converter is a component in the exhaust subsystem used to accelerate/generate chemical reactions within the engine exhaust to convert undesirable gases/pollutants into less harmful gases. In many spark-ignited applications, a three-way catalyst is used to convert hydrocarbons, oxides of nitrogen, and carbon monoxide into nitrogen, water, and carbon dioxide. In addition, many low-emission applications require the use of OBDM, which typically require a catalyst monitor to identify whether or not the catalyst is functioning properly. The catalyst monitor diagnostic is configured such that exhaust emissions are near compliance-failing levels based on the engines specific regulatory requirement(s). Catalyst monitor techniques typically utilize a HEGO sensor to monitor the amount of oxygen present downstream of the catalyst. This is generally a good indicator of how efficiently the catalyst is using the oxygen entering the catalyst.

The ECM uses a HEGO sensor for catalyst monitor. The HEGO is a switching-type sensor around stoichiometry that measures the oxygen content downstream of the catalyst for two main functions: 1) to compare it to the oxygen content upstream of the catalyst to determine how efficiently the catalyst is using oxygen to determine its effectiveness and 2) trim the commanded equivalence ratio target to maximize the catalyst conversion efficiency. The post-catalyst strategy and diagnostic is only active when the system is in either “CL Active” or “CL + Adapt” control modes.
DTC 0420 - Catalyst Inactive on Bank 1
SPN - 3050; FMI - 11

Diagnostic Aids

NOTE: If any other DTC's are present, diagnose those first.

☐ Exhaust Leak - Pressurize the exhaust system with 1-2 psi of air and check for pressure leaks upstream and around the catalyst and post-catalyst HEGO sensor. Replace gaskets and tighten fasteners if leaks are present.

☐ Perform Lake Test, allowing engine to warm-up to operating temperature and maintain average cruise speed to ensure DTC does not return.
• Bank 2 Catalyst, Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 4-After Catalyst)
• Check Condition- Engine Running
• Fault Condition- Bank 1 catalyst inactive on gasoline
• Corrective Action(s)- Illuminate MIL and/or sound audible warning.
• Emissions related fault

A catalyst or catalytic converter is a component in the exhaust subsystem used to accelerate/generate chemical reactions within the engine exhaust to convert undesirable gases/pollutants into less harmful gases. In many spark-ignited applications, a three-way catalyst is used to convert hydrocarbons, oxides of nitrogen, and carbon monoxide into nitrogen, water, and carbon dioxide. In addition, many low-emission applications require the use of OBDM, which typically require a catalyst monitor to identify whether or not the catalyst is functioning properly. The catalyst monitor diagnostic is configured such that exhaust emissions are near compliance-failing levels based on the engines specific regulatory requirement(s). Catalyst monitor techniques typically utilize a HEGO sensor to monitor the amount of oxygen present downstream of the catalyst. This is generally a good indicator of how efficiently the catalyst is using the oxygen entering the catalyst.

The ECM uses a HEGO sensor for catalyst monitor. The HEGO is a switching-type sensor around stoichiometry that measures the oxygen content downstream of the catalyst for two main functions: 1) to compare it to the oxygen content upstream of the catalyst to determine how efficiently the catalyst is using oxygen to determine its effectiveness and 2) trim the commanded equivalence ratio target to maximize the catalyst conversion efficiency. The post-catalyst strategy and diagnostic is only active when the system is in either “CL Active” or “CL + Adapt” control modes.
Diagnostic Aids

NOTE: If any other DTC’s are present, diagnose those first.

- Exhaust Leak - Pressurize the exhaust system with 1-2 psi of air and check for pressure leaks upstream and around the catalyst and post-catalyst HEGO sensor. Replace gaskets and tighten fasteners if leaks are present.

- Perform Lake Test, allowing engine to warm-up to operating temperature and maintain average cruise speed to ensure DTC does not return.
DTC 0502 - Boatspeed Input Loss of Signal
SPN - 84; FMI - 8

- Boat Speed (Paddlewheel OR GPS Input)
- **Check Condition** - Key on, Engine on
- **Fault Condition** - Boat speed less than 1.0 km/hr and engine speed greater than 2000 RPM with MAP greater than 10.00 psia; OR Instantaneous Dropout Detection: Engine speed greater than 1200 RPM with initial boat speed greater than 10.0 km/hr for at least 1000 ms followed by boat speed less than or equal to 2.0 km/hr for at least 200 ms after dropping boat speed faster than 200 ms
- **Corrective Action(s)** - Illuminate secondary warning lamp
- Non-emissions related fault
DTC 0502 - Boatspeed Input Loss of Signal
SPN - 84; FMI - 8
DTC 0521 - Oil Pressure Sensor - High Pressure
SPN - 100; FMI - 0

- Engine Oil Pressure
- Check Condition - Key on, Engine on
- Fault Condition - Oil pressure higher than 90.0 psia while engine speed is less than 3000 RPM.
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM monitors oil pressure through a proportional transducer. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

This fault sets if the engine oil pressure is higher than 90.0 psia and engine speed less than 3000 RPM as defined in the diagnostic calibration.
DTC 0521 - Oil Pressure Sensor - High Pressure
SPN - 100; FMI - 0

- Engine Running

Does DST display oil pressure > 90 psig?
  - Yes
  - Key OFF
  - Disconnect oil pressure sensor electrical connector
  - Key ON, Engine OFF
  - Operate at an engine speed at or above that recorded when the fault previously set based on the fault snapshot?
  - Does DST display oil pressure > 90 psig?
    - Yes
    - Oil pressure sensor signal circuit shorted to ground
    - Faulty ECM
    - Does DST display oil pressure voltage > 4.90 volts?
      - Yes
      - Jumper Oil pressure signal circuit to 5Vrtn at the sensor connector
      - Faulty connection at sensor
      - Faulty engine oiling system
      - Faulty oil pressure sensor
      - Does DST display oil pressure voltage < 0.10 volts?
        - Yes
        - Jumper Oil pressure signal circuit to ground at the sensor connector
        - Open oil pressure ground (5Vrtn1) circuit
        - Faulty connection at sensor
        - Faulty engine oiling system
        - Faulty oil pressure sensor
        - Does DST display oil pressure voltage < 0.10 volts?
          - No
          - Faulty harness, open signal circuit
    - No
    - Faulty ECM connection
  - No
  - Key OFF
  - Disconnect wiring harness connector from ECM
  - Carefully remove the yellow lock from the connector
  - CAREFULLY check resistance on oil pressure sensor signal circuit between the ECM connector and oil pressure sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.
  - Is the resistance < 5 ohms?
    - Yes
    - Faulty ECM connection
    - Faulty ECM
    - No
    - Faulty harness, open signal circuit
DTC 0522 - Oil Pressure Sensor - Low Voltage  
SPN - 100; FMI - 4

- Engine Oil Pressure
- **Check Condition** - Key on, Engine on
- **Fault Condition** - Oil pressure sensor voltage lower than 0.20 volts
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM monitors oil pressure through a proportional transducer. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

This fault sets if the engine oil pressure voltage is less than 0.20 volts as defined in the diagnostic calibration.
DTC 0522 - Oil Pressure Sensor - Low Voltage
SPN - 100; FMI - 4

- Engine Running

Does DST display oil pressure voltage < 0.20 volts?
- Yes
  - Key OFF
  - Disconnect Oil pressure sensor electrical connector
  - Key ON, Engine OFF
- No
  - Intermittent Fault

Does DST display oil pressure voltage > 4.90 volts?
- Yes
  - Faulty Oil pressure sensor
- No
  - Oil pressure sensor signal circuit shorted to ground
  - Faulty ECM
DTC 0523 - Oil Pressure Sensor - High Voltage
SPN - 100; FMI - 3

- Engine Oil Pressure
- **Check Condition** - Key on, Engine on
- **Fault Condition** - Oil pressure sensor voltage higher than 4.80 volts
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM monitors oil pressure through a proportional transducer. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

This fault sets if the engine oil pressure is higher than 4.80 volts as defined in the diagnostic calibration.
DTC 0523 - Oil Pressure Sensor - High Voltage
SPN - 100; FMI - 3

- Engine Running

Does DST display oil pressure > 4.80 volts?

- Key OFF
- Disconnect oil pressure sensor electrical connector
- Key ON, Engine OFF

Does DST display oil pressure voltage > 4.80 volts?

- Jumper Oil pressure signal circuit to 5Vrtn at the sensor connector

Does DST display oil pressure voltage < 0.10 volts?

- Faulty connection at sensor
- Faulty engine oiling system
- Faulty oil pressure sensor

- Key OFF
- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector

- CAREFULLY check resistance on oil pressure sensor signal circuit between the ECM connector and oil pressure sensor connector. **NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.**

Is the resistance < 5 ohms?

- Faulty ECM connection
- Faulty ECM

- Faulty harness, open signal circuit

- Intermittent Fault
DTC 0524 - Oil Pressure Sensor - Low Pressure
SPN - 100; FMI - 1

- Engine Oil Pressure
- **Check Condition** - Key on, Engine on
- **Fault Condition** - Engine oil pressure lower than expected while engine has been running for a minimum amount of time while engine speed is above some limit as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, generally configured to derate the engine and trigger an engine shutdown
- Non-emissions related fault

The ECM monitors oil pressure through a proportional transducer. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

This fault sets if the engine has been running for at least 10.0 seconds and oil pressure is less than 5.0 psia at idle and linear up to oil pressure less than 24.0 psia at 4000 RPM as defined in the diagnostic calibration.
DTC 0524 - Oil Pressure Sensor - Low Pressure
SPN - 100; FMI - 1

- Engine Running
- Using DST, clear DTC's

- Warm engine at idle to normal operating temperature
- Increase RPM to 3000 RPM

Does DTC 524 reset?

Yes

- Key OFF
- Disconnect Oil pressure sensor electrical connector
- Clear DTC's
- Engine Running
- Run engine at idle for at least one minute
- Increase RPM to 3000 RPM

Does DTC 524 reset?

Yes

- Oil pressure signal circuit shorted to ground
- Faulty ECM

No

- Faulty oil pressure sensor
- Faulty engine oiling system (verify with mechanical gauge)

No

- Intermittent Fault
DTC 0562 - Battery Voltage (Vbat) Low
SPN - 168; FMI - 17

- System voltage to ECM
- Check Condition - Key on, Engine on
- Fault Condition - Battery voltage to ECM less than 10.0 volts while the engine is operating at 1500 RPM or greater as defined in the diagnostic calibration
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle
- Non-emissions related fault

The battery voltage powers the ECM and must be within limits to correctly operate injector drivers, ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

This fault will set if the ECM detects system voltage less than 10.0 volts while the engine is operating at 1500 RPM as defined in the diagnostic calibration as the alternator should be charging the system. The adaptive learn is disabled to avoid improper adaptive learning due to the inability to correctly time injector firings.
DTC 0562 - Battery Voltage (Vbat) Low
SPN - 168; FMI - 17

- Engine Running
- Operate engine at idle

- Using DST, monitor battery voltage

Is battery voltage > 10.0 volts?

Yes → Intermittent Fault

No

- Using a DMM, measure the voltage potential across battery (+) and (-)

Is battery voltage > 10.0 volts?

Yes → Faulty Vbat power or ground circuit to ECM

No

- Faulty battery
- Faulty charging system
- Faulty ECM
DTC 0563 - Battery Voltage (Vbat) High  
SPN - 168; FMI - 15

- System voltage to ECM  
- **Check Condition** - Key on, Engine Cranking or Running  
- **Fault Condition** - Battery voltage to ECM greater than 16.0 volts while the engine is running as defined in the diagnostic calibration  
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle  
- Non-emissions related fault

The battery voltage powers the ECM and must be within limits to correctly operate injector drivers, ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

This fault will set if the ECM detects system voltage greater than 16.0 volts while the engine is running or cranking as defined in the diagnostic calibration. The adaptive learn is disabled to avoid improper adaptive learning.
DTC 0563 - Battery Voltage (Vbat) High
SPN - 168; FMI - 15

- Engine Running
  - Operate engine at idle

- Using DST, monitor battery voltage

Is battery voltage < 16.0 volts?
  - Yes
    - Intermittent Fault
  - No

- Using a DMM, measure the voltage potential across battery (+) and (-)

Is battery voltage < 16.0 volts?
  - Yes
    - Faulty ECM
  - No
    - Key OFF
    - Disconnect ECM electrical connector
    - Using a DMM, measure the voltage potential across battery (+) and (-)

Is battery voltage < 16.0 volts?
  - Yes
    - Faulty charging system
  - No
    - Faulty battery
• Engine Control Module- Flash Memory
• Check Condition - Key on
• Fault Condition - Internal microprocessor error
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle, recommend power derate 2 and low rev limit to reduce possible engine damage and/or overspeed condition
• Non-emissions related fault

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

If this fault sets, the ECM will reset itself and log the code. The fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code. This fault should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition. A fault of flash memory can occur for any calibration variable set and thus could cause undesirable operation.
DTC 0601 - Microprocessor Failure - FLASH
SPN - 628; FMI - 13

- Engine Running
- Operate engine at idle

- Using DST, clear DTC's

- Does DTC 601 reset with engine idling?
  - Yes
    - Check ALL power and ground circuits to ECM
  - No
    - Intermittent Fault

- Are all circuits OK?
  - Yes
    - Replace ECM with known good part and retest
  - No
    - Repair wiring to ECM and retest
Engine Control Module- Random Access Memory

Check Condition - Key on

Fault Condition - Internal ECM microprocessor memory access failure

Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle, recommend power derate 2 and low rev limit to reduce possible engine damage and/or overspeed condition

Non-emissions related fault

Random Access Memory is located within the microprocessor and can be read from or written to at any time. Data stored in RAM include DTCs (when fault configuration is set to “Battery Power Retained”), adaptive fuel learn tables, octane adaptation table, misfire adaption tables, and closed loop fuel multipliers. The ECM has checks that must be satisfied each time an instruction is executed.

This fault will set if the ECM detects a problem accessing or writing information to RAM and should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition. If this fault sets, the ECM will reset itself and log the code. This fault should be erased by a technician after diagnostics are performed. The fault should be configured to never forget and will not self-erase.
DTC 0604 - Microprocessor Failure - RAM
SPN - 630; FMI - 12

- Engine Running
- Operate engine at idle

- Using DST, clear DTC’s

Does DTC 604 reset with engine idling?

- Intermittent Fault

Are all circuits OK?

- Repair wiring to ECM and retest

- Replace ECM with known good part and retest

- Check ALL power and ground circuits to ECM

Yes
• Engine Control Module
• *Check Condition* - Key on
• *Fault Condition* - Internal microprocessor error
• *Corrective Action(s)* - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle, recommend power derate 2 and low rev limit to reduce possible engine damage and/or overspeed condition
• Non-emissions related fault

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

If this fault sets, the ECM will reset itself and log the code. The fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code. This fault should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition.
DTC 0606 - Microprocessor Failure - COP
SPN - 629; FMI - 31

- Engine Running
- Operate engine at idle

- Using DST, clear DTC's

Does DTC 0606 reset with engine idling?
- Yes
  - Check ALL power and ground circuits to ECM

  Are all circuits OK?
- Yes
  - Replace ECM with known good part and retest

- No
  - Intermittent Fault
  - Repair wiring to ECM and retest
DTC 0627 - Fuel Pump Relay Coil Open
SPN - 1348; FMI - 5

- Fuel Pump Relay
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - Fuel Pump relay coil output open circuit
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the fuel pump relay is detected as an open circuit. If this fault is active the fuel pump will not receive power and the engine will not run on gasoline.
**DTC 0627 - Fuel Pump Relay Coil Open**

**SPN - 1348; FMI - 5**

- **Key ON, Engine OFF**
- **Remove fuel pump relay from fuse block**
- **External Power Test Mode - All ON**
- **Using a DMM, measure the voltage potential from the fuel pump relay output to ground while the engine is trying to crank**

**Is voltage > 80% of Vbat?**

- **No**
  - **Faulty fuel pump relay**
- **Yes**
  - **Key OFF**
  - **Connect test lamp to Vbat and Fuel Pump Relay output**
  - **Key ON, Engine OFF**
  - **External Power Test Mode - All ON**

**Does test lamp stay illuminated?**

- **No**
  - **Faulty fuel pump relay**
  - **Faulty relay connection/wiring**
- **Yes**

**Key OFF**
- **Disconnect wiring harness connector from ECM**
- **Carefully remove the yellow lock from the connector**
- **CAREFULLY check resistance on fuel pump relay output circuit between the ECM connector and relay connection (fuse block). NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.**

**Does DMM indicate resistance < 5.0 ohms?**

- **No**
  - **Faulty harness, open circuit**
- **Yes**
  - **Faulty ECM**
DTC 0628 - Fuel Pump Relay Control Ground Short
SPN - 1348; FMI - 4

- Fuel Pump Relay
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - Fuel Pump relay coil output shorted to ground
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the fuel pump relay is detected as being shorted to ground. If this fault is active and the high-side of the fuel pump relay is supplied, the fuel pump will run until the relay or high-side power is removed.
DTC 0628 - Fuel Pump Relay Control Ground Short
SPN - 1348; FMI - 4

- Key ON, Engine OFF
- Remove fuel pump relay from fuse block
- Is DTC 628 active?
  - No
    - External Power Test Mode - All ON
    - Using a DMM, measure the voltage potential from the fuel pump relay output to ground
    - Is voltage > 80% of Vbat?
      - No
        - Faulty fuel pump relay
      - Yes
        - Faulty fuel pump relay
  - Yes
    - Key ON, Engine OFF
    - Using a DMM, measure the resistance from the fuel pump relay output to ground
    - Is the resistance < 10 ohms?
      - No
        - Faulty fuel pump relay
      - Yes
        - Faulty harness, short to ground
        - Key OFF
          - Disconnect ECM electrical connector
          - Using a DMM, measure the resistance from the fuel pump relay output to ground
          - Is the resistance < 10 ohms?
            - Yes
              - Faulty ECM
            - No
              - Faulty ECM
DTC 0629 - Fuel Pump Relay Coil Short to Power
SPN - 1348; FMI - 3

- Fuel Pump Relay
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - Fuel Pump relay coil output short to power/voltage
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the fuel pump relay is detected as shorted to power. If this fault is active the fuel pump will not receive power and will not run.
DTC 0629 - Fuel Pump Relay Coil Short to Power
SPN - 1348; FMI - 3

- Key ON, Engine OFF
- Remove fuel pump relay from fuse block

Is DTC 629 active?

No

- External Power Test Mode - All ON
- Using a DMM, measure the voltage potential from the fuel pump relay output to ground

Is voltage > 80% of Vbat?

No

- Faulty fuel pump relay

Yes

- Key ON, Engine OFF
- Using a DMM, measure the resistance from the fuel pump relay output to Vbat

Is the resistance < 10 ohms?

No

- Faulty fuel pump relay

Yes

- Key OFF
- Disconnect ECM electrical connector
- Using a DMM, measure the resistance from the fuel pump relay output to Vbat

Is the resistance < 10 ohms?

No

- Faulty harness, short to power

Yes

- Faulty ECM

No

- Faulty ECM
DTC 0642 - Sensor Supply Voltage 1 Low (5Vref1)
SPN - 1079; FMI - 4

- **External 5V Reference**
- **Check Condition** - Cranking with battery voltage greater than 8 volts or engine running.
- **Fault Condition** - 5V Reference voltage lower than 4.6 volts.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning
- **Non-emissions related fault**

The external 5-volt supply powers some of the sensors and other components in the system. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is over-loaded, shorted, or otherwise out of specification.
DTC 0642 - Sensor Supply Voltage 1 Low (5Vref1)
SPN - 1079; FMI - 4

- Engine Running

Does DST display DTC 642?

Yes

- Ignition OFF.
- Disconnect ECM connector.
- Using a DMM, check for continuity between ECM 5V Reference pin and ground.

No

Do you have continuity?

Yes

- MAP
- Oil Pressure Sensor
- Throttle Body
- Throttle Control Positioning (TCP) Sensor
- Crankshaft Position Sensor
- Camshaft Position Sensor

No

Did you lose continuity when disconnecting each sensor/component?

Yes

- Replace the faulty sensor.

No

- Intermittent Fault
- Perform “wiggle test” on the wiring at sensor locations.

- While monitoring the DMM for continuity between the ECM 5V Reference and engine ground, disconnect each of the following sensors/components one at a time to find the shorted 5V reference. When continuity to ground is lost, the last sensor/component disconnected is the area of suspicion. Inspect the 5V reference supply wire leads for shorts before replacing the sensor/component.

- Replace Faulty ECM

- Intermittent Fault
- Perform “wiggle test” on the wiring at sensor locations.

- While monitoring the DMM for continuity between the ECM 5V Reference and engine ground, disconnect each of the following sensors/components one at a time to find the shorted 5V reference. When continuity to ground is lost, the last sensor/component disconnected is the area of suspicion. Inspect the 5V reference supply wire leads for shorts before replacing the sensor/component.

- Replace the faulty sensor.
DTC 0643 - Sensor Supply Voltage 1 High (5Vref1)
SPN - 1079; FMI - 3

- **External 5V Reference**
- **Check Condition** - Cranking with battery voltage greater than 8 volts or engine running.
- **Fault Condition** - 5V Reference voltage higher than 5.4 volts.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning
- **Non-emissions related fault**

The external 5-volt supply powers some of the sensors and other components in the system. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is over-loaded, shorted, or otherwise out of specification.
DTC 0643 - Sensor Supply Voltage 1 High (5Vref1)
SPN - 1079; FMI - 3

- Engine Running
- Intermittent Fault
- Perform “wiggle test” on the wiring at sensor locations.

Does DST display DTC 643?

- Yes
  - Check ALL ECM grounds. Refer to wiring schematics for your part number harness.

Are the ground connections good?

- Yes
  - Ignition OFF.
  - Disconnect the ECM connector.
  - Using a DMM, check for voltage between ECM harness pin “19” and engine ground.

Do you have voltage?

- Yes
  - Repair the 5-volt circuit as necessary.

- No
  - Replace Faulty ECM

- No
  - Repair the bad ECM ground circuit(s) as necessary.

- No
  - Replace Faulty ECM
DTC 0650 - Malfunction Indicator Lamp (MIL) Open
SPN - 1213; FMI - 5

- MIL
- **Check Condition** - Key On, Engine Off or Running
- **Fault Condition** - ECM MIL output open circuit.
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

This ECM output is used to provide a low-side switch to a MIL that is used to indicate that an emission related fault has been set.

This fault will set if the ECM detects that there is no load connected to the MIL output. There are many applications that utilize Digital Dash Displays that act as the MIL. In these cases, the MIL is activated over the CAN BUS system to alert the operator. These applications may not have a separate MIL connected to the ECM output and will exhibit this as an Active DTC all the time. That is normal, ignore this code in those applications.
DTC 0650 - Malfunction Indicator Lamp (MIL) Open
SPN - 1213; FMI - 5

- Key ON, Engine OFF

Does this boat have a MIL?

Note: Many boats now use a digital display on the dash which incorporates the MIL function. The boat may not be equipped with a MIL

Yes

- Disconnect output signal from the MIL
- Using a DMM, measure the voltage potential from the MIL to ground

Is voltage > 80% of Vbat?

No

- Faulty MIL

- Key ON, Engine OFF

No

- Faulty MIL lamp/LED
- Faulty wiring, open circuit

Yes

Does test lamp stay illuminated?

Yes

- Key OFF
- Connect a test lamp from Vbat to MIL output circuit
- Key ON, Engine OFF

No

- Faulty MIL lamp/LED
- Faulty wiring, open circuit

Key OFF

Disconnect wiring harness connector from ECM
Carefully remove the yellow lock from the connector

- CAREFULLY check resistance on MIL output circuit between the ECM connector and MIL lamp/LED. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Does DMM indicate resistance < 5 ohms?

Yes

- Faulty ECM

No

- Faulty harness, open circuit

- Key OFF

- Faulty MIL lamp/LED
- Faulty wiring, open circuit
DTC 0652 - Sensor Supply Voltage 2 Low (5Vref2)
SPN - 1080; FMI - 4

- External 5V Reference
- **Check Condition** - Cranking with battery voltage greater than 8 volts or engine running.
- **Fault Condition** - 5V Reference 2 voltage lower than 3.0 volts.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning
- Non-emissions related fault

The external 5-volt supply 2 is a dedicated supply voltage to power the TCP Sensor 2 for redundancy. The accuracy of the 5-volt supply is very important to the accuracy of the sensor and therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is over-loaded, shorted, or otherwise out of specification.
DTC 0652 - Sensor Supply Voltage 2 Low (5Vref2)
SPN - 1080; FMI - 4

• Engine Running

Does DST display DTC 652?

Yes

No

• Check ALL ECM grounds. Refer to wiring schematics for your part number harness.

Are the ground connections good?

Yes

No

• Ignition OFF.
• Disconnect the ECM connector.
• Using a DMM, check for voltage between ECM harness pin “49” and engine ground.

Do you have voltage?

Yes

No

• Repair the 5-volt circuit as necessary.
• Replace Faulty ECM

• Intermittent Fault
• Perform “wiggle test” on the wiring at sensor location.

No

Yes

• Repair the bad ECM ground circuit(s) as necessary.
• Replace Faulty ECM

Do you have voltage?
DTC 0653 - Sensor Supply Voltage 2 High (5Vref2)
SPN - 1080; FMI - 3

- External 5V Reference
- **Check Condition** - Cranking with battery voltage greater than 8 volts or engine running.
- **Fault Condition** - 5V Reference 2 voltage higher than 5.4 volts.
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning
- Non-emissions related fault

The external 5-volt supply 2 is a dedicated supply voltage to power the TCP Sensor 2 for redundancy. The accuracy of the 5-volt supply is very important to the accuracy of the sensor and therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is over-loaded, shorted, or otherwise out of specification.
DTC 0653 - Sensor Supply Voltage 2 High (5Vref2)
SPN - 1080; FMI - 3

- Engine Running
- Intermittent Fault
- Perform “wiggle test” on the wiring at sensor location.

Does DST display DTC 653?

- Yes
  - Check ALL ECM grounds. Refer to wiring schematics for your part number harness.

- No
  - Perform “wiggle test” on the wiring at sensor location.

Are the ground connections good?

- Yes
  - Repair the 5-volt circuit as necessary.

- No
  - Repair the bad ECM ground circuit(s) as necessary.

- Ignition OFF.
- Disconnect the ECM connector.
- Using a DMM, check for voltage between ECM harness pin “49” and engine ground.

Do you have voltage?

- Yes
  - Repair the 5-volt circuit as necessary.

- No
  - Replace Faulty ECM
DTC 0685 - Power Relay Coil Open
SPN - 1485; FMI - 5

- Power Relay
- *Check Condition* - Key On, Engine Off
- *Fault Condition* - Power relay coil output open circuit
- *Corrective Action(s)* - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the power relay is detected as an open circuit. If this fault is active the injector and ignition coil high-side will not receive power and the engine will not run.
DTC 0685 - Power Relay Coil Open
SPN - 1485; FMI - 5

• Key ON, Engine OFF

• Remove power relay from fuse block
• External Power Test Mode - All ON
• Using a DMM, measure the voltage potential from the power relay output to ground while the engine is trying to crank

Is voltage > 80% of Vbat?

Yes

• Key OFF
• Connect test lamp to Vbat and Power Relay output
• Key ON, Engine OFF
• External Power Test Mode - All ON

Does test lamp stay illuminated?

Yes

• Faulty power relay
• Faulty relay connection/wiring

No

• Key OFF
• Disconnect wiring harness connector from ECM
• Carefully remove the yellow lock from the connector
• CAREFULLY check resistance on power relay output circuit between the ECM connector and relay connection (fuse block). NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Does DMM indicate resistance < 5.0 ohms?

Yes

• Faulty ECM

No

• Faulty harness, open circuit
DTC 0686 - Power Relay Control Ground Short
SPN - 1485; FMI - 4

- **Power Relay**
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - Power relay coil output shorted to ground
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- **Non-emissions related fault**

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the power relay is detected as being shorted to ground.
DTC 0686 - Power Relay Control Ground Short
SPN - 1485; FMI - 4

Key ON, Engine OFF

Remove power relay from fuse block

Is DTC 686 active?

No

External Power Test Mode - All ON
Using a DMM, measure the voltage potential from the power relay output to ground

Is voltage > 80% of Vbat?

No

Faulty power relay

Yes

Key ON, Engine OFF
Using a DMM, measure the resistance from the power relay output to ground

Is the resistance < 10 ohms?

No

Faulty power relay

Yes

Key ON, Engine OFF
Using a DMM, measure the resistance from the power relay output to ground

Is the resistance < 10 ohms?

No

Faulty harness, short to ground

Yes

Faulty ECM

No
DTC 0687 - Power Relay Coil Short to Power
SPN - 1485; FMI - 3

- Power Relay
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - Power relay coil output short to power/voltage
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

This fault sets if the output for the power relay is detected as shorted to power.
DTC 0687 - Power Relay Coil Short to Power  
SPN - 1485; FMI - 3

- Key ON, Engine OFF
- Remove power relay from fuse block

- Is DTC 687 active?
  - Yes
  - Key ON, Engine OFF  
  - Using a DMM, measure the resistance from the power relay output to Vbat

  - Is the resistance < 10 ohms?
    - Yes
    - Key OFF  
    - Disconnect ECM electrical connector  
    - Using a DMM, measure the resistance from the power relay output to Vbat

    - Is the resistance < 10 ohms?
      - Yes
      - Faulty ECM

    - No
      - Faulty harness, short to power

  - No
    - Faulty power relay

- No

- External Power Test Mode - All ON
- Using a DMM, measure the voltage potential from the power relay output to ground

- Is voltage > 80% of Vbat?
  - Yes
  - Faulty power relay

  - No
    - Faulty power relay
DTC 1111 - RPM Above Fuel Rev Limit Level
SPN - 515; FMI - 16

- Fuel Rev Limit - Crankshaft Position Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Engine speed greater than the Fuel Rev Limit speed as defined in the diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable fuel injectors or gaseous fuel control actuator to limit speed. Recommend disabling closed loop and adaptive learn fueling corrections while fault is active
- Non-emissions related fault

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage and will disable fuel injectors or gaseous fuel actuator to reduce engine speed. The throttle will also be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override.
DTC 1111 - RPM Above Fuel Rev Limit Level
SPN - 515; FMI - 16

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

☐ Check mechanical operation of the throttle
☐ Check the engine intake for large air leaks downstream of the throttle body
DTC 1112 - RPM Above Spark Rev Limit Level
SPN - 515; FMI - 0

- Spark Rev Limit - Crankshaft Position Sensor
- Check Condition - Engine Running
- Fault Condition - Engine speed greater than the Spark Rev Limit speed as defined in the diagnostic calibration
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable ignition coils. Recommend disabling closed loop and adaptive learn fueling corrections while fault is active
- Non-emissions related fault

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage and will disable the ignition coils to reduce engine speed. In addition, the throttle will be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override and the fuel injectors or gaseous fuel control actuator will be disabled to reduce the engine speed below the speed set in the diagnostic calibration for Fuel Rev Limit.
DTC 1112 - RPM Above Spark Rev Limit Level
SPN - 515; FMI - 0

**Diagnostic Aids**

NOTE: If any other DTCs are present, diagnose those first.

- Check mechanical operation of the throttle
- Check the engine intake for large air leaks downstream of the throttle body
• Electronic Throttle Control Position (TCP) Sensor
• Check Condition - Key On, Engine Off
• Fault Condition - TCP1 and TCP2 %’s do not correlate and neither correlate with IVS state
• Corrective Action(s) - Illuminate MIL, sound audible warning or illuminate secondary warning lamp, and forced idle
• Non-emissions related fault

The TCP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the vehicle/engine operator. A TCP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of two potentiometers with IVS. The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are generally used to ensure safe, reliable operation.

This fault is only applicable for dual potentiometer/single IVS sensors and indicates that TCP1 and TCP2 percentages correlate and register an off-idle condition but the IVS state reads at idle throughout the entire operating range.
DTC 1121 - TCP1 & TCP2 Simultaneous Voltages Out-of-Range (Redundancy Lost)
SPN - 91; FMI - 31

Diagnostic Aids

- For TCP1 Out-of-Range - Troubleshoot according to DTC 2122 TCP1 High Voltage and DTC 2123 TCP1 Low Voltage procedures.

- For TCP2 Out-of-Range - Troubleshoot according to DTC 2127 TCP2 Low Voltage and DTC 2128 TCP2 High Voltage procedures.
• Electronic foot pedal/throttle control sensor
• **Check Condition** - Key On, Engine Off
• **Fault Condition** - TCP1 and TCP2 %’s do not correlate and neither correlate with IVS state
• **Corrective Action(s)** - Illuminate MIL, sound audible warning or illuminate secondary warning lamp, and forced idle
• Non-emissions related fault

The TCP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the vehicle/engine operator. A TCP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of single potentiometer with IVS, two potentiometers, or two potentiometers with IVS. The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are generally used to ensure safe, reliable operation.

This fault is only applicable for dual potentiometer/single IVS sensors and indicates that TCP1 and TCP2 percentages do not correlate with each other and neither of the two potentiometers correlate with the IVS.
DTC 1122 - FPP1 & FPP2 Do Not Match Each Other or IVS
SPN - 520199; FMI - 11

Diagnostic Aids

- For TCP1 and TCP2 Do Not Match - Troubleshoot according to DTC 2121 TCP1 Lower Than TCP2 and DTC 2126 TCP1 Higher Than TCP2 procedures.

- For TCP1 and TCP2 Do Not Match IVS - Troubleshoot according to DTC 2115 TCP1 Higher Than IVS Limit and DTC 2116 TCP2 Higher Than IVS Limits procedures.
• Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)
• Check Condition - Engine Running
• Fault Condition - Bank 1 closed loop fuel multiplier higher than defined in diagnostic calibration
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
• Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction “learning” the fueling deviation.

This fault sets if the closed loop multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the fuel injection system, 3) a non-responsive HEGO sensor, and/or 3) an injector that is stuck closed.
Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Vacuum Leaks** - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.

- **Injectors** - System will be lean if an injector driver or driver circuit fails. The system will also be lean if an injector fails in a closed manner or is dirty.

- **Fuel Pressure** - System will be lean if fuel pressure is too low. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.

- **Air in Fuel** - If the fuel return hose/line is too close to the fuel supply pickup in the fuel tank, air may become entrapped in the pump or supply line causing a lean condition and driveability problems.

- **Exhaust Leaks** - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.

- **Fuel Quality** - A drastic variation in fuel quality may cause the system to be lean including oxygenated fuels.

- **System Grounding** - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.

- If all tests are OK, replace the HO2S sensor with a known good part and retest.
DTC 1156 - Closed Loop Bank 1 Low
SPN - 4236; FMI - 1

- Heated Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - Bank 1 closed loop fuel multiplier lower than defined in diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction “learning” the fueling deviation.

This fault sets if the closed loop multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the fuel injection system, 2) a non-responsive HEGO sensor, and/or 3) an injector that is stuck open.
## Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.
- **Injectors** - System will be rich if an injector driver or driver circuit fails shorted-to-ground. The system will also be rich if an injector fails in an open.
- **Fuel Pressure** - System will be rich if fuel pressure is too high. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.
- **System Grounding** - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- **If all tests are OK,** replace the HO2S sensor with a known good part and retest.
DTC 1157 - Closed Loop Bank 2 High
SPN - 4238; FMI - 0

• Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 1/Bank 2-Before Catalyst)
• Check Condition - Engine Running
• Fault Condition - Bank 2 closed loop fuel multiplier higher than defined in diagnostic calibration
• Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
• Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction “learning” the fueling deviation.

This fault sets if the closed loop multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the fuel injection system, 3) a non-responsive HEGO sensor, and/or 3) an injector that is stuck closed.
# DTC 1157 - Closed Loop Bank 2 High

**SPN - 4238; FMI - 0**

<table>
<thead>
<tr>
<th>Diagnostic Aids</th>
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<tbody>
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</tbody>
</table>
DTC 1158 - Closed Loop Bank 2 Low
SPN - 4238; FMI - 1

- Heated Exhaust Gas Oxygen Sensor (Bank 2-Sensor 1/Bank 2-Before Catalyst)
- **Check Condition** - Engine Running
- **Fault Condition** - Bank 2 closed loop fuel multiplier lower than defined in diagnostic calibration
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and possibly disable closed-loop fueling correction during active fault.
- Emissions related fault

The HEGO sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. If there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then “learned” with the Adaptive multiplier. The multipliers only update when the system is in either “CL Active” or “CL + Adapt” control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction “learning” the fueling deviation.

This fault sets if the closed loop multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the fuel injection system, 2) a non-responsive HEGO sensor, and/or 3) an injector that is stuck open.
DTC 1158 - Closed Loop Bank 2 Low
SPN - 4238; FMI - 1

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness

☐ Injectors - System will be rich if an injector driver or driver circuit fails shorted-to-ground. The system will also be rich if an injector fails in an open.

☐ Fuel Pressure - System will be rich if fuel pressure is too high. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.

☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.

☐ If all tests are OK, replace the HO2S sensor with a known good part and retest.
DTC 1311 - Misfire Detected Cylinder #1
SPN - 1323; FMI - 11

- Cylinder #1 Misfire Detected - Driveability/Performance
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder's rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine's driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per "bank" fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that bank's aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1311 - Misfire Detected Cylinder #1
SPN - 1323; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 1312 - Misfire Detected Cylinder #2
SPN - 1324; FMI - 11

- Cylinder #2 Misfire Detected - Driveability/Performance
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine's driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1312 - Misfire Detected Cylinder #2
SPN - 1324; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.
- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.
- **Spark Plug(s)** - Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).
- **Spark Plug Wire(s)** - Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).
- **Fuel Pressure** - Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.
- **Cylinder Check** - Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.
- **Exhaust Leak** - Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 1313 - Misfire Detected Cylinder #3
SPN - 1325; FMI - 11

- Cylinder #3 Misfire Detected - Driveability/Performance
- **Check Condition** - Key On, Engine Running
- **Fault Condition** - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- **Emissions related fault**

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1313 - Misfire Detected Cylinder #3  
SPN - 1325; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- □ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness

- □ Oil Level- Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- □ Spark Plug(s) – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- □ Spark Plug Wire(s) – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- □ Fuel Pressure – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- □ Cylinder Check – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- □ Exhaust Leak – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 1314 - Misfire Detected Cylinder #4
SPN - 1326; FMI - 11

- Cylinder #4 Misfire Detected - Driveability/Performance
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1314 - Misfire Detected Cylinder #4  
SPN - 1326; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

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**Diagnostic Aids**

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 1315 - Misfire Detected Cylinder #5
SPN - 1327; FMI - 11

- Cylinder #5 Misfire Detected - Driveability/Performance
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1315 - Misfire Detected Cylinder #5
SPN - 1327; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.
- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.
- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).
- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).
- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.
- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.
- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
Cylinder #6 Misfire Detected - Driveability/Performance

Check Condition - Key On, Engine Running

Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage

Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.

Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that bank’s aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:

1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1316 - Misfire Detected Cylinder #6  
SPN - 1328; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

## Diagnostic Aids

**NOTE:** If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
DTC 1317 - Misfire Detected Cylinder #7
SPN - 1329; FMI - 11

- Cylinder #7 Misfire Detected - Driveability/Performance
- Check Condition - Key On, Engine Running
- Fault Condition - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage
- Corrective Action(s) - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- Oil Level - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacturer maintenance procedures.

- Spark Plug(s) – Check for fouled or damaged spark plugs. Replace and regap according to manufacturer recommended procedure(s).

- Spark Plug Wire(s) – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacturer recommended procedure(s).

- Fuel Pressure – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- Cylinder Check – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- Exhaust Leak – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacturer recommended procedure(s).

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.
DTC 1318 - Misfire Detected Cylinder #8  
SPN - 1330; FMI - 11

- Cylinder #8 Misfire Detected - Driveability/Performance  
- **Check Condition** - Key On, Engine Running  
- **Fault Condition** - Misfire occurrences higher than allowed for each operating condition calibrated at a level that can result in poor driveability but not necessarily catalyst damage  
- **Corrective Action(s)** - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction for key-cycle, and disable closed-loop fueling correction during active fault.  
- Emissions related fault

The ECU is capable of detecting combustion misfire for certain crank-cam software modules. The ECU continuously monitors changes in crankshaft angular velocity, comparing acceleration rates on a cycle-to-cycle basis and determining if a given cylinder’s rate of change is abnormal compared to other cylinders. This method of detection is better known as Instant Crank Angle Velocity (ICAV).

Misfire is of concern for four main reasons: 1) damage can occur to aftertreatment systems due to the presence of unburned fuel and oxygen causing chemical reactions resulting in extremely high temperatures causing irreversible damage to catalytic coatings and/or substrates, 2) exhaust emissions increase during misfiring, 3) the engine’s driveability suffers due to inconsistent operation, and 4) fuel economy suffers due to the need for higher power operating conditions to achieve the same brake torque. The GCP has two stages of misfire faults 1) emissions/catalyst damaging misfire detected and 2) driveability or general misfire detected.

Emissions/catalyst misfire is generally thought of as a per “bank” fault as multiple cylinders misfiring on the same bank cumulatively add unburned fuel and oxygen to that banks aftertreatment device(s). The catalyst/emissions fault is configured to set based on one or both of the following conditions:  
1) Aftertreatment temperatures experienced during this level of misfire are high enough to cause permanent damage to emission control components  
2) Emissions are higher than allowed by legislation due to the presence or misfire.

Therefore, if two cylinders misfire on the same bank together they both may set the misfire fault even if neither cylinder individually exceeds the catalyst/misfire threshold.

Typically the driveability level is calibrated to set prior to the emissions/catalyst level if a two stage fault is desired. This fault would set to notify the user of a problem prior to it causing damage to the exhaust aftertreatment system.
DTC 1318 - Misfire Detected Cylinder #8
SPN - 1330; FMI - 11

Misfire is typically a result of one or more factors. These factors can include but may not be limited to: 1) a fouled or damaged spark plug(s), 2) a damaged or defective ignition coil(s) or coil wire(s) resulting in weak spark generation, 3) a plugged or contaminated injector(s) that intermittently sticks closed resulting in a lean cylinder charge, 4) an injector(s) that is stuck open causing an uncontrolled rich cylinder charge, 5) low fuel supply pressure resulting in multiple lean cylinders, 6) low cylinder compression due to a failed or worn piston ring(s) or non-seating valve(s) can result in a low cylinder pressure charge that may not be ignited, and 7) an exhaust leak in close proximity to an exhaust valve permitting uncontrolled amounts of oxygen to be drawn into a cylinder generating an excessively lean charge either directly resulting in misfire or possibly causing excessive combustion temperatures resulting in burned valves and loss of compression. Misfire can be difficult to correct as it may be a function of one or more of the conditions mentioned above and may require checking and/or changing several components for each cylinder or cylinders affected.

This fault sets if the misfire counter for cylinder #1 exceeds the driveability misfire limit set in the misfire diagnostic calibration and is based on a percentage of misfire over a certain number of engine cycles.

### Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- **Oxygen Sensor Wire** - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

- **Oil Level** - Many engines have valve trains that utilize lifters that are hydraulically actuated and require specific levels of oil to maintain proper pressure for lifter actuation. If the engine has improper oil, insufficient oil level, or has too much oil the hydraulic lifters may not function as intended causing changes in valve lift and timing. As a result, incomplete combustion may occur as a result of oil problems. Check engine oil level and oil type according to manufacture maintenance procedures.

- **Spark Plug(s)** – Check for fouled or damaged spark plugs. Replace and regap according to manufacture recommended procedure(s).

- **Spark Plug Wire(s)** – Check that spark plug wire is properly connected to ignition coil and spark plug. If equipped, ensure that spark plug terminal nut is tight to plug and that there is not substantial wear on nut. Check for cracks in insulation of spark plug wire or boot. Replace spark plug wire(s) if deemed necessary according to manufacture recommended procedure(s).

- **Fuel Pressure** – Check fuel rail pressure at key-on/engine-off or with External Power-All On test running. Monitor fuel rail pressure when key is turned off to determine if fuel pressure bleeds down too quickly. Run an injector fire test on a couple of injectors to monitor the pressure drop in the rail for each injector. If an injector appears to flow inconsistent compared to others, replace and retest.

- **Cylinder Check** – Run a compression test and cylinder leak test on suspected cylinder(s) to check mechanical integrity of piston rings and valve seats.

- **Exhaust Leak** – Pressurize exhaust system with 1-2 psig of air and check for pressure leaks around exhaust manifold gasket and pre-catalyst EGO sensor. Replace gasket(s) and tighten fasteners according to manufacture recommended procedure(s).
Exhaust Manifold Water Temperature (EMWT) Sensor

Check Condition - Engine Running

Fault Condition - EMWT1 sensor voltage higher than the limit defined in the diagnostic calibration

Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.

Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 4.90 VDC.
**DTC 1411 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Voltage High**

**SPN - 441; FMI - 3**

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**Key ON, Engine OFF**

- **Does DST display EMWT1 Temperature < 0°F?**
  - Yes
    - Disconnect EMWT1 sensor electrical connector
    - Jumper across the terminals at connector
    - **Does DST display EMWT1 Temperature > 260°F?**
      - Yes
        - Faulty connection to sensor
        - Faulty EMWT1 sensor
      - No
        - Jumper EMWT1 sensor signal to known good ground
  - No
    - Intermittent Problem
- **Yes**

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**Does DST display EMWT1 Temperature > 260°F?**

- Yes
  - Open EMWT1 sensor ground (5Vtrn) circuit
  - Faulty connection to sensor
  - Faulty EMWT1 sensor
- No

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**Key OFF**

- Disconnect wiring harness connector from ECM
- Carefully remove the yellow lock from the connector
- **CAREFULLY** check resistance on EMWT1 signal circuit between the ECM connector and EMWT1 sensor connector. **NOTE: DO NOT INSERT** probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

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**Is the resistance < 5 ohms?**

- Yes
  - Faulty ECM connection
  - Faulty ECM
- No

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**DTC 1412 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Voltage High**

**SPN - 442; FMI - 3**

- **Exhaust Manifold Water Temperature (EMWT) Sensor**
- **Check Condition** - Engine Running
- **Fault Condition** - EMWT2 sensor voltage higher than the limit defined in the diagnostic calibration
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.
- **Non-emissions related fault**

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 4.90 VDC.
DTC 1412 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Voltage High
SPN - 442; FMI - 3

Key ON, Engine OFF

Does DST display EMWT2 Temperature < 0°F?

Yes
• Disconnect EMWT2 sensor electrical connector
• Jumper across the terminals at connector

No
Intermittent Problem

Does DST display EMWT2 Temperature > 260°F?

Yes
• Faulty connection to sensor
• Faulty EMWT2 sensor

No
Jumper EMWT2 sensor signal to known good ground

Does DST display EMWT2 Temperature > 260°F?

Yes
• Open EMWT2 sensor ground (5Vrtn) circuit
• Faulty connection to sensor
• Faulty EMWT2 sensor

No

• Key OFF
• Disconnect wiring harness connector from ECM
• Carefully remove the yellow lock from the connector

• CAREFULLY check resistance on EMWT2 signal circuit between the ECM connector and EMWT2 sensor connector. NOTE: DO NOT INSERT probe or object into terminals as this will cause the terminal to spread and may no longer make contact with ECM pin. Spread pins will void warranty! Probe on the side of the terminal.

Is the resistance < 5 ohms?

Yes
• Faulty ECM connection
• Faulty ECM

No
• Faulty Harness
DTC 1413 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Voltage Low
SPN - 441; FMI - 4

- Exhaust Manifold Water Temperature (EMWT) Sensor
- Check Condition - Engine Running
- Fault Condition - ECT sensor voltage less than the limit defined in the diagnostic calibration
- Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration.
  Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is less than the limit defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 0.10 VDC.
DTC 1413 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Voltage Low
SPN - 441; FMI - 4

Ignition ON, Engine OFF

Does DST display EMWT1 Temperature > 260°F?

Yes
• Key OFF
• Disconnect EMWT1 sensor electrical connector
• Key ON, Engine OFF

No
Intermittent Problem

Does DST display EMWT1 Temperature < 0°F?

Yes
Replace faulty EMWT1 sensor

No

Does DST display EMWT1 Temperature < 0°F?

Yes
Repair faulty EMWT1 signal circuit as necessary.

No

• Using a DMM, check for EMWT1 sensor signal circuit shorted to ground
• Was a problem found?

No
Replace faulty ECM.
DTC 1414 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Voltage Low
SPN - 442; FMI - 4

- Exhaust Manifold Water Temperature (EMWT) Sensor
- Check Condition - Engine Running
- Fault Condition - ECT sensor voltage less than the limit defined in the diagnostic calibration
- Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault, or any combination thereof as defined in calibration. Recommend a power derate 1/2 to reduce the possibility of engine damage due to the inability to sense temperature.
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is less than the limit defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 0.10 VDC.
DTC 1414 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Voltage Low
SPN - 442; FMI - 4

Ignition ON, Engine OFF

Does DST display EMWT2 Temperature > 260°F?

Yes

- Key OFF
- Disconnect EMWT2 sensor electrical connector
- Key ON, Engine OFF

No

Intermittent Problem

Does DST display EMWT2 Temperature < 0°F?

Yes

Replace faulty EMWT2 sensor

No

Does DST display EMWT2 Temperature < 0°F?

Yes

- Using a DMM, check for EMWT2 sensor signal circuit shorted to ground
- Was a problem found?

Replacement EMWT2 sensor

No

Repair faulty EMWT2 signal circuit as necessary.

Replace faulty ECM.
DTC 1415 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Higher Than Expected
Stage 1
SPN - 441; FMI - 15

- Exhaust Manifold Water Temperature (EMWT) Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Exhaust Manifold Water Temperature reading or estimate greater than the stage 1 limit when operating at a speed greater than defined in the diagnostic calibration
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set.
Diagnostic Aids

- If the “EMWT1 High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “EMWT1 Sensor Higher Than Expected 1.”
- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking
- Ensure that there is no trapped air in the cooling path
- Inspect the cooling system for cracks and ensure connections are leak free
- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected
- Check that the thermostat is not stuck closed
- Check that the raw water pump/impeller is tact and that it is not restricted
- Verify that the proper amount of raw water flow is being achieved, both static and underway
DTC 1416 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Higher Than Expected
Stage 1
SPN - 442; FMI - 15

- Exhaust Manifold Water Temperature (EMWT) Sensor
- Check Condition - Engine Running
- Fault Condition - Exhaust Manifold Water Temperature reading or estimate greater than the stage 1 limit when operating at a speed greater than defined in the diagnostic calibration
- Corrective Action(s) - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set.
Diagnostic Aids

- If the “EMWT2 High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “EMWT2 Sensor Higher Than Expected 1.”

- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking

- Ensure that there is no trapped air in the cooling path

- Inspect the cooling system for cracks and ensure connections are leak free

- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected

- Check that the thermostat is not stuck closed

- Check that the raw water pump/impeller is tact and that it is not restricted

- Verify that the proper amount of raw water flow is being achieved, both static and underway
DTC 1417 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Higher Than Expected  
Stage 2  
SPN - 441; FMI - 0

- Exhaust Manifold Water Temperature (EMWT) Sensor  
- **Check Condition** - Engine Running  
- **Fault Condition** - Exhaust Manifold Water Temperature reading or estimate greater than the stage 1 limit when operating at a speed greater than defined in the diagnostic calibration  
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.  
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set.
## DTC 1417 - Exhaust Manifold Water Temperature (EMWT) Sensor 1 Higher Than Expected
### Stage 2
**SPN - 441; FMI - 0**

### Diagnostic Aids
- If the “EMWT1 High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “EMWT1 Sensor Higher Than Expected 2.”
- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking.
- Ensure that there is no trapped air in the cooling path.
- Inspect the cooling system for cracks and ensure connections are leak free.
- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected.
- Check that the thermostat is not stuck closed.
- Check that the raw water pump/impeller is tact and that it is not restricted.
- Verify that the proper amount of raw water flow is being achieved, both static and underway.
DTC 1418 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Higher Than Expected
Stage 2
SPN - 442; FMI - 0

- Exhaust Manifold Water Temperature (EMWT) Sensor
- **Check Condition** - Engine Running
- **Fault Condition** - Exhaust Manifold Water Temperature reading or estimate greater than the stage 1 limit when operating at a speed greater than defined in the diagnostic calibration
- **Corrective Action(s)** - Sound audible warning or illuminate secondary warning lamp, disable adaptive learn fueling correction during active fault. Recommend a power derate 1/2 and/or a low rev limit to protect engine from possible damage.
- Non-emissions related fault

The EMWT sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. There is one located in each CES exhaust manifold. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set.
### DTC 1418 - Exhaust Manifold Water Temperature (EMWT) Sensor 2 Higher Than Expected
#### Stage 2
**SPN - 442; FMI - 0**

#### Diagnostic Aids
- If the “EMWT2 High Voltage” fault is also present, follow the troubleshooting procedures for that fault as it may have caused “EMWT2 Sensor Higher Than Expected 2.”
- Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking.
- Ensure that there is no trapped air in the cooling path.
- Inspect the cooling system for cracks and ensure connections are leak free.
- Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected.
- Check that the thermostat is not stuck closed.
- Check that the raw water pump/impeller is tact and that it is not restricted.
- Verify that the proper amount of raw water flow is being achieved, both static and underway.
DTC 1542 - AUX Analog PUD 1 - Low Voltage
SPN - 704; FMI - 4

- AUX Analog PUD1 - Transmission Overtemp Switch
- *Check Condition* - Key on, Engine Cranking or Running
- *Fault Condition* - Battery voltage to ECM greater than x volts while the engine is running as defined in the diagnostic calibration
- *Corrective Action(s)* - Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp, disable adaptive fueling correction for remainder of key cycle
- Non-emissions related fault

The battery voltage powers the ECM and must be within limits to correctly operate injector drivers, ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

This fault will set if the ECM detects system voltage greater than x volts while the engine is running or cranking as defined in the diagnostic calibration. The adaptive learn is disabled to avoid improper adaptive learning.
DTC 1542 - AUX Analog PUD 1 - Low Voltage
SPN - 704; FMI - 4
DTC 1611 - Sensor Supply Voltage (5Vref 1/2) Simultaneously Out-of-Range
SPN - 1079; FMI - 31

- Powered sensors/actuators and FPP2
- **Check Condition** - Engine on
- **Fault Condition** - high or low voltage feedback on both 5V_ext1 and 5V_ext2
- **Corrective Action(s)** - Illuminate MIL, sound audible warning or illuminate secondary warning lamp, and forced idle
- Non-emissions related fault

5V_ext1 is a regulated 5 VDC output that supplies power to sensors and actuators. This power is generally supplied, but is not limited to hall-effects, potentiometers, switches, and pressure transducers. 5V_ext2 is a low-current 5 VDC power supply intended solely for powering a second potentiometer used for electronic throttle control in configurations where high redundancy is required. High accuracy of the power supplies are required in order to ensure proper signal scaling. Both power supplies have a feedback voltage that is monitored by the ECM to determine if the output is overloaded, shorted, or otherwise out of specification.

This fault indicates that both power supply feedback voltages are out-of-range as defined in the calibration. In configurations where the crank and/or camshaft position sensors are powered hall-effect sensors, the engine may stall due to loss of synchronization.
DTC 1611 - Sensor Supply Voltage (5Vref 1/2) Simultaneously Out-of-Range
SPN - 1079; FMI - 31

- Key ON, Engine OFF
- Verify DTC 1611 is Active
- Disconnect TCP sensor from engine wiring harness

Does DST indicate DTC 1611 as active?

No
- Faulty TCP sensor, replace sensor

Yes
- Key OFF
- Disconnect ALL 5VREF powered sensors/actuators from the engine wiring harness
- Key ON, Engine OFF

Does DST indicate DTC 1611 as active?

Yes
- Faulty original TCP sensor

No
- Replace Faulty sensor(s)
- Repair faulty sensor(s) wiring harness

- Repair faulty wiring harness
- Faulty ECM
• Engine Control Module
• **Check Condition** - Key on
• **Fault Condition** - Internal microprocessor error
• MIL - On until code is cleared by technician
• Adaptive - Disabled for the remainder of the key-on cycle
• Closed Loop - Enabled
• Power Derate (level 2 until fault is cleared manually)

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.
DTC 1612 - Microprocessor Failure - RTI 1
SPN - 629; FMI - 31

- Engine running
- Using DST, clear DTC's

Does DTC 1612 reset with engine idling?

Yes
- Check ALL power and ground circuits to ECM

No
- Intermittent fault

Are ALL circuits OK?

Yes
- Replace ECM with known good part and retest

No
- Repair faulty wiring to ECM and retest
• Engine Control Module
• *Check Condition* - Key on
• *Fault Condition* - Internal microprocessor error
• MIL - On until code is cleared by technician
• Adaptive - Disabled for the remainder of the key-on cycle
• Closed Loop - Enabled
• Power Derate (level 2 until fault is cleared manually)

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.
DTC 1613 - Microprocessor Failure - RTI 2
SPN - 629; FMI - 31

- Engine running
- Using DST, clear DTC's

Does DTC 1613 reset with engine idling?

Yes
- Check ALL power and ground circuits to ECM

No
- Intermittent fault

Are ALL circuits OK?

Yes
- Replace ECM with known good part and retest

No
- Repair faulty wiring to ECM and retest
DTC 1614 - Microprocessor Failure - RTI 3
SPN - 629; FMI - 31

- Engine Control Module
- **Check Condition** - Key on
- **Fault Condition** - Internal microprocessor error
- MIL - On until code is cleared by technician
- Adaptive - Disabled for the remainder of the key-on cycle
- Closed Loop - Enabled
- Power Derate (level 2 until fault is cleared manually)

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.
DTC 1614 - Microprocessor Failure - RTI 3
SPN - 629; FMI - 31

- Engine running
- Using DST, clear DTC's

Does DTC 1614 reset with engine idling? [ ] Yes [ ] No

- Intermittent fault

- Check ALL power and ground circuits to ECM

Are ALL circuits OK? [ ] Yes [ ] No

- Repair faulty wiring to ECM and retest
- Replace ECM with known good part and retest
DTC 1615 - Microprocessor Failure - A/D  
SPN - 629; FMI - 31

- Engine Control Module
- Check Condition - Key on
- Fault Condition - Internal microprocessor error
- MIL - On until code is cleared by technician
- Adaptive - Disabled for the remainder of the key-on cycle
- Closed Loop - Enabled
- Power Derate (level 2 until fault is cleared manually)

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.
DTC 1615 - Microprocessor Failure - A/D
SPN - 629; FMI - 31

- Engine running
- Using DST, clear DTC's

Does DTC 1615 reset with engine idling?

Yes

- Check ALL power and ground circuits to ECM

Are ALL circuits OK?

Yes

- Replace ECM with known good part and retest

No

- Repair faulty wiring to ECM and retest

No

- Intermittent fault
DTC 1616 - Microprocessor Failure - Interrupt
SPN - 629; FMI - 31

- Engine Control Module
- **Check Condition** - Key on
- **Fault Condition** - Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive - Disabled for the remainder of the key-on cycle
- Closed Loop - Enabled
- Power Derate (level 2 until fault is cleared manually)

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.
DTC 1616 - Microprocessor Failure - Interrupt
SPN - 629; FMI - 31

- Engine running
- Using DST, clear DTC's

Does DTC 1616 reset with engine idling?

Yes

- Check ALL power and ground circuits to ECM

No

- Intermittent fault

Are ALL circuits OK?

Yes

- Replace ECM with known good part and retest

No

- Repair faulty wiring to ECM and retest
Throttle Body / Throttle Position Sensor

Check Condition - Cranking or Running

Fault Condition - Throttle command is 20 percent less than the throttle position for 200ms or longer.

MIL - On during active fault

Buzzer - On during active fault

Low Rev Limit and Forced Idle is activated

There are two throttle position sensors located within the throttle body which use variable resistors to determine signal voltage based on the throttle blade position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

This fault will set if the throttle command is 20 percent less than the actual throttle position. During this active fault, the MIL will be illuminated and “forced idle” mode will be activated.
DTC 2111 - Unable to Reach Lower TPS
SPN - 51; FMI - 7

Ignition ON, Engine OFF

• DST connected
• Go to Tests tab and activate DBW Test Mode
• Advance throttle handle until throttle command is between 63 and 68 percent

Is the TPS1 voltage greater than 2.0 volts?

No

Intermittent Problem

Yes

• Ignition OFF
• Disconnect throttle body electrical connector
• Using a test lamp connected to battery voltage, probe the TPS1 signal circuit
• Ignition ON

Does the DST display TPS1 voltage less than 0.2 volts?

Yes

No

Intermittent Problem

Is there voltage present?

Yes

• DST connected
• Go to Tests tab and activate DBW Test Mode
• Advance throttle handle until throttle command is between 63 and 68 percent

No

Replace ECM

Is replacement complete?

Yes

• Remove all test equipment except for the DST
• Connect any disconnected components, connectors, etc.
• Ignition ON, engine OFF. Clear DTC information from the ECM
• Ignition OFF for 30 seconds
• Start the engine and operate the boat at normal operating temperature and observe the MIL
• Observe engine driveability and performance
• After operation within the test parameters of DTC 2111, check for any stored DTC’s

Is engine operate normally with no DTC’s?

Yes

System OK

No

Repeat DTC Chart

Does the test lamp illuminate?

Yes

Check throttle body for foreign objects.

No

Did you find any foreign objects in the throttle bore?

Yes

Remove foreign object.

Warning! Turn off all electrical power to the engine before attempting to remove any objects from the throttle blade area. DO NOT reach into the throttle blade area with fingers. Serious injury or amputation could occur if throttle blade is energized with fingers in the throttle blade area.

Has the object been removed?

No

Repair the open in the ground circuit wire

Repair the faulty circuit as necessary.

Was a problem found?

Yes

Replace the throttle body

No

Replace the throttle body

Repair the open in the ground circuit wire

Inspect the throttle body wire harness connector terminals for damage, corrosion or contamination.

Do you have continuity?

Yes

No

Replace the open in the ground circuit wire

Is the replacement complete?

Yes

No

Replacing the open in the ground circuit wire

Repair the faulty circuit as necessary.

Repeat DTC Chart

Using a test lamp connected to battery voltage, back probe the sensor ground circuit at the ECM connector.

• Ignition OFF
• Disconnect ECM electrical connector
• Using a DVOM, check for continuity between throttle body connector TPS1 ground circuit and ECM connector 5Vth ground circuit terminals.

Do you have continuity?

Yes

No

Repair the open in the ground circuit wire

Is the replacement complete?

Yes

No

Replace ECM

Repair the short to voltage on TPS1 signal wire

ECM0708
DTC 2112 - Unable to Reach Higher TPS
SPN - 51; FMI - 7

- Throttle Body / Throttle Position Sensor
- **Check Condition** - Cranking or Running
- **Fault Condition** - Throttle command is 20 percent more than the throttle position for 200ms or longer.
- MIL - On during active fault
- Buzzer - On during active fault
- Low Rev Limit and Forced Idle is activated

There are two throttle position sensors located within the throttle body which use variable resistors to determine signal voltage based on the throttle blade position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

This fault will set if the throttle command is 20 percent more than the actual throttle position. During this active fault, the MIL will be illuminated and “forced idle” mode will be activated.
DTC 2112 - Unable to Reach Higher TPS
SPN - 51; FMI - 7

Ignition ON, Engine OFF

- DST connected
- Go to Tests tab and activate DBW Test Mode
- Advance throttle handle until throttle command is between 63 and 68 percent

Is the TPS1 voltage greater than 2.0 volts?

No

Intermittent Problem

Yes

- Ignition OFF
- Disconnect throttle body electrical connector
- Using a test lamp connected to battery voltage, probe the TPS1 signal circuit
- Ignition ON

Is the TPS1 voltage greater than 4.0 volts?

Yes

- DST connected
- Using a DVOM, check for continuity between the throttle body connector TPS1 signal wire, pin “D” and engine ground.

Is there continuity?

No

Repair the open circuit on TPS1 signal wire

Yes

Replace ECM

Is replacement complete?

No

Repair the short to ground on TPS1 signal wire

Yes

Replace ECM

Did you find any foreign objects in the throttle bore?

Yes

- Remove foreign object.

Warning! Turn off all electrical power to the engine before attempting to remove any objects from the throttle blade area. DO NOT reach into the throttle blade area with fingers. Serious injury or amputation could occur if throttle blade is energized with fingers in the throttle blade area.

Has the object been removed?

No

- Remove foreign object.

Yes

Inspect the throttle body wire harness connector terminals for damage, corrosion or contamination.

Was a problem found?

No

Replace the throttle body

Yes

Repair the faulty circuit as necessary.

Does the DST display TPS1 voltage greater than 4.0 volts?

Yes

No

Is there continuity?

Yes

Repair the short to ground on TPS1 signal wire

No

Replace ECM

Is replacement complete?

Yes

System OK

No

Repeat DTC Chart

Does engine operate normally with no DTC’s?

Yes

System OK

No

Repeat DTC Chart
The engine load command to the ECM is determined by operator depression of the electronic foot pedal. The ECM monitors the foot pedal position and controls the throttle to maintain the commanded power level. Because a problem with the foot pedal signal can result in a higher or lower power than intended by the operator, the pedal used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the pedal is depressed more than the idle position.

This fault will set if the IVS is at idle (open) and the TCP voltage is greater than 1.2 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 20% and the maximum engine speed is 1600 RPM. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.
DTC 2115 - TCP Sensor 1 Higher Than IVS Limit
SPN - 91; FMI - 0

Ignition ON, Engine OFF

Does DST display IVS “At Idle” with the throttle fully open?

Yes

• Ignition OFF
• Disconnect TCP Sensor from the harness.
• Ignition ON.

No

• Move throttle until TCP1 voltage is between 1.1 and 1.3 volts.

Does DST display IVS “At Idle”?

Yes

Replace Faulty TCP Sensor

No

Intermittent Problem

Does DST display IVS “At Idle”?

Yes

Replace Faulty TCP Sensor

No

Repair IVS circuit shorted to ground. If OK, replace faulty ECM.
DTC 2116 - TCP Sensor 2 Higher Than IVS Limit
SPN - 29; FMI - 0

- Throttle Control Position/Idle Validation Switch (IVS)
- **Check Condition** - Engine Cranking or Running
- **Fault Condition** - IVS at idle and TCP voltage greater than 1.2 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle

The engine load command to the ECM is determined by operator depression of the electronic foot pedal. The ECM monitors the foot pedal position and controls the throttle to maintain the commanded power level. Because a problem with the foot pedal signal can result in a higher or lower power than intended by the operator, the pedal used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the pedal is depressed more than the idle position.

This fault will set if the IVS is at idle (open) and the TCP voltage is greater than 1.2 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 20% and the maximum engine speed is 1600 RPM. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.
DTC 2116 - TCP Sensor 2 Higher Than IVS Limit
SPN - 29; FMI - 0

Ignition ON, Engine OFF

Does DST display IVS “At Idle” with the throttle fully open?

Yes

- Ignition OFF
- Disconnect TCP Sensor from the harness.
- Ignition ON.

No

- Move throttle until TCP1 voltage is between 1.1 and 1.3 volts.

Does DST display IVS “At Idle”?

Yes

- Replace Faulty TCP Sensor

No

Intermittent Problem

Does DST display IVS “At Idle”?

Yes

- Replace Faulty TCP Sensor

No

Repair IVS circuit shorted to ground. If OK, replace faulty ECM.
Electronic Throttle Control Position (TCP) Sensor

- **Check Condition** - Ignition ON, Engine OFF
- **Fault Condition** - TCP1 Voltage out-of-range, TCP2% does not match IVS state
- Corrective Action(s) - Illuminate MIL, sound audible warning and forced idle
- Non-emissions related fault

The TCP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the engine operator. A TCP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of two potentiometers with IVS. The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are generally used to ensure safe, reliable operation.

This fault is only applicable with dual potentiometer/single IVS sensors and indicates that TCP1 voltage is out-of-range and TCP2% does not correlate with the IVS state resulting in a loss of redundancy.
DTC 2120 - TCP Sensor 1 Invalid Voltage and TCP Sensor 2 Disagrees with IVS
SPN - 520199; FMI - 11

Diagnostic Aids

□ **For TCP1 Invalid Voltage** - Troubleshoot according to *DTC 2122 TCP1 High Voltage* and *DTC 2123 TCP1 Low Voltage* procedures.

□ **For TCP2 Disagrees with IVS** - Troubleshoot according to *DTC 2116 TCP2 Higher Than IVS Limit* and *DTC 2140 TCP2 Lower Than IVS Limit* procedures.
DTC 2121 - TCP Sensor 1 Lower Than TCP Sensor 2
SPN - 91; FMI - 18

- Electronic foot pedal/throttle control sensor
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - TCP1% lower than TCP2%
- Corrective Action(s) - Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle
- Non-emissions related fault

The TCP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the engine operator. A TCP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of two potentiometers with IVS. The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are generally used to ensure safe, reliable operation.

This fault indicates that the measured % deflection of sensor 1 is less than sensor 2 by an amount defined in calibration.
DTC 2121 - TCP Sensor 1 Lower Than TCP Sensor 2
SPN - 91; FMI - 18

1. **Ignition ON, Engine OFF**
   - Ensure that the sensor is securely mounted to the bracket and not broken.
   - Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

2. **Does DST display TCP1 voltage between 0.42 and 0.46 and TCP2 voltage between 0.17 and 0.21?**
   - Yes: Open the sensor to the fully open position.
   - No: Using the DST, adjust the TCP sensor to achieve 0.42-0.46 volts.

3. **Were you able to adjust the sensor and achieve 0.44-0.46 volts for TCP1 voltage?**
   - Yes: Clear DTC and take test.
   - No: Ignition ON, engine OFF.
     - Disconnect TCP sensor electrical connector.
     - Using a DMM, measure the voltage between pin "1" (5V1 return) and pin "6" (5V1 supply).

4. **Does voltage measure between 4.60-5.40 volts?**
   - Yes: Replace faulty TCP sensor.
   - No: Using a DMM, measure the voltage between a known good ground and pin "6" (5V1 supply).

5. **Does voltage measure between 4.60-5.40 volts?**
   - Yes: Repair faulty ground circuit or replace faulty ECM.
   - No: Repair faulty 5V1 circuit or replace faulty ECM.

**Intermittent Fault.**

**System OK.**
DTC 2122 - TCP Sensor 1 High Voltage
SPN - 91; FMI - 3

- Throttle Control Position (TCP) Sensor
- Check Condition - Ignition ON
- Fault Condition - TCP1 sensor voltage exceeds 4.8
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The Throttle Control Position (TCP) sensor uses a variable resistor to determine signal voltage based on throttle lever position. Less movement of the throttle lever results in lower voltage, and greater movement results in higher voltage.

This fault will set if voltage is over 4.8 volts at any operating condition while the key is on. If the voltage exceeds 4.8, then TCP1 is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level 1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The Low Rev Limit is enforced for the remainder of the key-on cycle. Rev limit is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.
DTC 2122 - TCP Sensor 1 High Voltage
SPN - 91; FMI - 3

Ignition ON, Engine OFF

- Ensure that the sensor is securely mounted to the bracket and not broken.
- Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

Does DST display TCP1 voltage at 4.80 volts or greater while at the idle position?

No

- Slowly increase throttle while observing TCP1 sensor voltage.

Yes

- Ignition OFF.
- Disconnect TCP Sensor electrical connector.
- Ignition ON.

Does DST ever display TCP1 sensor voltage at 4.80 volts or greater?

No

- Intermittent Fault

Yes

Does DST display TCP1 sensor voltage at 0.20 volts or less?

No

- Repair faulty signal circuit shorted to voltage.
- If OK, replace faulty ECM.

Yes

Does the test lamp illuminate?

No

- Repair faulty open TCP1 ground circuit.
- If OK, replace faulty ECM.

Yes

- Using a test lamp connected to battery voltage, probe the TCP1 ground circuit.

- Repair faulty ECM connection.
- If OK, replace faulty TCP Sensor.
DTC 2123 - TCP Sensor 1 Low Voltage
SPN - 91; FMI - 4

- Throttle Control Position (TCP) Sensor
- **Check Condition** - Ignition ON
- **Fault Condition** - TCP1 sensor voltage lower than 0.2 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The Throttle Control Position (TCP) sensor uses a variable resistor to determine signal voltage based on throttle lever position. Less movement of the throttle lever results in lower voltage, and greater movement results in higher voltage.

This fault will set if voltage is less than 0.2 volts at any operating condition while the key is on. If the voltage goes lower than 0.2 volts, then TCP1 is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level 1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The Low Rev Limit is enforced for the remainder of the key-on cycle. Rev limit is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.
DTC 2123 - TCP Sensor 1 Low Voltage
SPN - 91; FMI - 4

Ignition ON, Engine OFF

- Ensure that the sensor is securely mounted to the bracket and not broken.
- Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

Does DST display TCP1 sensor voltage at 0.25 volts or lower while at the idle position?

Yes

- Slowly increase throttle while observing TCP1 sensor voltage.

No

- Does DST ever display TCP1 sensor voltage at 0.25 volts or lower?

Yes

- Ignition OFF.
- Disconnect TCP sensor electrical connector.
- Inspect the connector and wire terminals for damage, corrosion or contamination.

Was a problem found?

Yes

- Repair the faulty circuit.

No

- Ignition ON.
- Using a DMM, check for continuity between TCP1 connector 5 volt reference pin “6” and ECM connector pin “19.”

Is there continuity?

Yes

- Repair faulty circuit as necessary.

No

- Using a DMM, check for continuity between ECM connector pin “19” and engine ground.

Is there continuity?

Yes

- Repair faulty circuit as necessary.

No

- Using a DMM, check for continuity between ECM connector pins “19” and ECM connector pin “20.”

Is there continuity?

Yes

- Repair faulty circuit as necessary.

No

- Using a DMM, check for continuity between TCP1 signal pin “5” and ECM connector pin “9.”

Is there continuity?

Yes

- Repair faulty TCP connection.

No

- Ignition OFF.
- Disconnect ECM wire harness connector.
- Using a DMM, check for voltage at the TCP connector between the 5 volt reference, pin “6” and sensor ground, pin “1.”

Is voltage 4.60 volts or greater?

Yes

- Replace faulty TCP sensor.

No

- Repair the faulty circuit.

• Repair faulty circuit(s).

Was a problem found?

Yes

- Replace faulty ECM.

No
DTC 2125 - TCP Sensor 2 Invalid Voltage and TCP Sensor 1 Disagrees with IVS
SPN - 520199; FMI - 11

• Electronic Throttle Control Position (TCP) Sensor
• **Check Condition** - Ignition On, Engine Off
• **Fault Condition** - TCP2 Voltage out-of-range, TCP1% does not match IVS state
• Corrective Action(s) - Illuminate MIL, sound audible warning and forced idle
• Non-emissions related fault

The TCP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the vehicle/engine operator. A TCP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of two potentiometers with IVS. The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are generally used to ensure safe, reliable operation.

This fault is only applicable with dual potentiometer/single IVS sensors and indicates that TCP2 voltage is out-of-range and TCP1% does not correlate with the IVS state resulting in a loss of redundancy.
DTC 2125 - TCP Sensor 2 Invalid Voltage and TCP Sensor 1 Disagrees with IVS
SPN - 520199; FMI - 11

Diagnostic Aids

- **For TCP2 Invalid Voltage** - Troubleshoot according to *DTC 2127 TCP2 Low Voltage* and *DTC 2128 TCP2 High Voltage* procedures.

- **For TCP1 Disagrees with IVS** - Troubleshoot according to *DTC 2115 TCP1 Higher Than IVS Limit* and *DTC 2139 TCP1 Lower Than IVS Limit* procedures.
DTC 2126 - TCP Sensor 1 Higher Than TCP Sensor 2
SPN - 91; FMI - 16

- Electronic foot pedal/throttle control sensor
- **Check Condition** - Key On, Engine Off
- **Fault Condition** - TCP1% higher than TCP2%
- Corrective Action(s) - Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle
- Non-emissions related fault

The engine load command to the ECM is determined by the operator advancement of the Throttle Control Position (TCP) sensor. The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP incorporates a sensor with an Idle Validation Switch (IVS). Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced off the idle position.

This fault will set if throttle control position sensor 1 is 20% higher than throttle control position sensor 2.
Ensure that the sensor is securely mounted to the bracket and not broken.

Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

Were you able to adjust the sensor and achieve 0.44-0.46 volts for TCP1 voltage?

Open the sensor to the fully open position.

Does DST display TCP1 voltage between 0.42 and 0.46 and TCP2 voltage between 0.17 and 0.21?

Using the DST, adjust the TCP sensor to achieve 0.42-0.46 volts.

Does DST display TCP1 voltage between 4.40 and 4.47 and TCP2 voltage between 2.0 and 2.20?

Open the sensor to the fully open position.

Does DST display TCP1 voltage between 4.60-5.40 volts?

Using a DMM, measure the voltage between pin "1" (5V1 return) and pin "6" (5V1 supply).

Using a DMM, measure the voltage between a known good ground and pin "6" (5V1 supply).

Does voltage measure between 4.60-5.40 volts?

Repair faulty TCP sensor.

Repair faulty ground circuit or replace faulty ECM.

System OK.
DTC 2127 - TCP Sensor 2 Low Voltage
SPN - 29; FMI - 4

- Throttle Control Position (TCP) Sensor
- **Check Condition** - Ignition ON
- **Fault Condition** - TCP2 sensor voltage lower than 0.15 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The Throttle Control Position (TCP) sensor uses a variable resistor to determine signal voltage based on throttle lever position. Less movement of the throttle lever results in lower voltage, and greater movement results in higher voltage.

This fault will set if voltage is less than 0.15 volts at any operating condition while the key is on. If the voltage goes lower than 0.15 volts, then TCP2 is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level 1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The Low Rev Limit is enforced for the remainder of the key-on cycle. Rev limit is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.
DTC 2127 - TCP Sensor 2 Low Voltage
SPN - 29; FMI - 4

Ignition ON, Engine OFF

- Ensure that the sensor is securely mounted to the bracket and not broken.
- Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

Does DST display TCP2 sensor voltage at 0.15 volts or lower while at the idle position?

No

- Slowly increase throttle while observing TCP2 sensor voltage.

Yes

Does DST display TCP2 sensor voltage at 0.15 volts or lower?

No

- Intermittent Fault.

Yes

- Ignition OFF.
- Disconnect TCP sensor electrical connector.
- Inspect the connector and wire terminals for damage, corrosion or contamination.

Was a problem found?

Yes

- Repair the faulty circuit.

No

- Ignition ON.
- Using a DMM, check for voltage at the TCP connector between the 5 volt reference, pin "4" and sensor ground, pin "2."

Is voltage 4.60 volts or greater?

No

- Repair the faulty circuit.

Yes

- Replace faulty TCP sensor.

Yes

- Using a test lamp connected to battery positive, probe the TCP2 connector signal circuit, pin "3."

Does DST display TCP2 sensor voltage at 4.60 volts or greater?

No

- Repair faulty circuit as necessary.

Yes

- Repair faulty circuit as necessary.

• Using a DMM, check for continuity between TCP2 connector 5 volt reference pin "4" and ECM connector pin "49."

Is there continuity?

No

- Repair faulty circuit as necessary.

Yes

- Using a DMM, check for continuity between ECM connector pin "49" and engine ground.

Is there continuity?

No

- Repair faulty circuit as necessary.

Yes

- Using a DMM, check for continuity between ECM connector pin "49" and ECM connector pin "50."

Is there continuity?

No

- Using a DMM, check for continuity between ECM connector pin "10" and engine ground.

Is there continuity?

No

- Using a DMM, check for continuity between ECM connector pin "10" and ECM connector pin "50."

Is there continuity?

Yes

- Inspect TCP and ECM connector terminals for damage, corrosion or contamination.

No

- Replace faulty ECM.

Yes

- Repair faulty ECM.

Was a problem found?

Yes

- Repair faulty circuit(s).
DTC 2128 - TCP Sensor 2 High Voltage
SPN - 29; FMI - 3

- Throttle Control Position (TCP) Sensor
- **Check Condition** - Ignition ON
- **Fault Condition** - TCP2 sensor voltage lower than 0.15 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The Throttle Control Position (TCP) sensor uses a variable resistor to determine signal voltage based on throttle lever position. Less movement of the throttle lever results in lower voltage, and greater movement results in higher voltage.

This fault will set if voltage is more than 4.80 volts at any operating condition while the key is on. If the voltage goes higher than 4.80 volts, then TCP2 is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level 1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The Low Rev Limit is enforced for the remainder of the key-on cycle. Rev limit is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.
**DTC 2128 - TCP Sensor 2 High Voltage**

**SPN - 29; FMI - 3**

**Ignition ON, Engine OFF**
- Ensure that the sensor is securely mounted to the bracket and not broken.
- Make sure throttle cable is adjusted properly to ensure that the sensor is at idle rest in neutral and WOT rest when throttle is advanced fully, with no extra tension on the sensor.

**Does DST display TCP2 sensor voltage at 4.60 volts or greater while at the idle position?**
- Yes
  - Slowly increase throttle while observing TCP2 sensor voltage.
- No
  - Does DST ever display TCP2 sensor voltage at 4.60 volts or greater?
    - Yes
      - Ignition OFF.
      - Disconnect TCP sensor electrical connector.
      - Disconnect TCP sensor electrical connector.
      - Using a test lamp connected to battery, probe TCP2 ground circuit, pin “2.”
    - No
      - Ignition OFF.
      - Disconnect ECM wiring harness connector.
      - Using a DMM, check for continuity between TCP2 sensor connector ground, pin “2” and ECM connector ground pin “50.”

**Was a problem found?**
- Yes
  - Repair the faulty circuit.
- No
  - Disconnect ECM connector.
  - Using a DMM, check for continuity between TCP2 sensor connector ground, pin “2” and ECM connector pin “50.”

**Is there continuity?**
- Yes
  - Ignition ON.
  - Using a DMM, check for voltage at the ECM wiring harness connector TCP2 signal circuit, pin “10.”
- No
  - Repair the faulty circuit.

**Is there voltage?**
- Yes
  - Repair the faulty circuit.
- No
  - Using a DMM, check for voltage between the ECM harness connector TCP2 signal circuit, pin “10” and engine ground.

**Is there voltage?**
- Yes
  - Repair the faulty circuit.
- No
  - Repair the faulty circuit.

**Neither problem found?**
- Yes
  - Replace faulty TCP sensor.
- No
  - Replace faulty ECM.
DTC 2130 - IVS Stuck At Idle, TCP Sensors 1/2 Match  
SPN - 558; FMI - 5

- Throttle Control Position (TCP) Sensor
- **Check Condition** - Ignition ON, engine running
- **Fault Condition** - TCP1 % is approximately TCP2 % and both are greater than TCP idle validation % and IVS = at idle
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle.

The Throttle Control Position (TCP) sensor consists of two potentiometers and an Idle Validation Switch (IVS). The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine’s load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine’s power output, redundant sensors are used to ensure safe and reliable operation.

This fault indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at-idle throughout the entire operating range.
DTC 2130 - IVS Stuck At Idle, TCP Sensors 1/2 Match
SPN - 558; FMI - 5

Ignition ON, Engine Running

- Operate engine at idle in neutral.
- Move the TCP sensor in order to achieve 2000 RPM.

Does the DST indicate IVS state "Off-Idle?"

Yes ➔ Intermittent Fault.

No ➔ Ignition OFF.
- Disconnect TCP sensor connector.
- Move TCP sensor to wide open throttle position and hold open.
- Using a DMM, measure the resistance between IVS input signal, pin “8” and IVS ground pin “7” at the TCP connector.

Is the resistance 1K ohms or greater?

Yes ➔ Replace faulty TCP sensor.

No ➔ Using a DMM, measure the resistance between TCP connector IVS ground, pin “7” and a known good engine ground.

Is there any resistance measured?

Yes ➔ Repair faulty wiring.

No ➔ Replace faulty ECM.
DTC 2131 - IVS Stuck Off idle, TCP Sensors 1/2 Match
SPN - 558; FMI - 6

- Throttle Control Position (TCP) Sensor
- **Check Condition** - Ignition ON, engine running
- **Fault Condition** - TCP1 % is approximately TCP2 % and both are less than TCP idle validation % and IVS = off-idle
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The Throttle Control Position (TCP) sensor consists of two potentiometers and an Idle Validation Switch (IVS). The TCP sensor outputs are proportional to the commanded input. The ECM uses the TCP sensor inputs to control the throttle and adjust the engine's load in order to achieve the requested power. Since the TCP sensor inputs directly affect the engine's power output, redundant sensors are used to ensure safe and reliable operation.

This fault indicates that the two TCP percentages correlate and register an at-idle condition but the IVS state reads off-idle throughout the entire operating range.
DTC 2131 - IVS Stuck Off Idle, TCP Sensors 1/2 Match
SPN - 558; FMI - 6

Ignition ON, Engine Running

- Operate engine at idle in neutral.
- Ensure the TCP sensor is securely mounted to the bracket.
- Ensure that the throttle cable is not holding the TCP sensor open and the TCP sensor is in the fully closed throttle position.

Does the DST indicate still indicate a DTC 2131?

No ➔ Intermittent Fault.

Yes ➔

- Ignition OFF.
- Disconnect TCP sensor connector.
- Move TCP sensor to wide open throttle position and hold open.
- Using a DMM, measure the resistance between IVS input signal, pin "8" and IVS ground pin "7" at the TCP connector.

Is the resistance 1K ohms or greater?

No ➔ Replace faulty TCP sensor.

Yes ➔

- Using a DMM, measure the resistance between TCP connector IVS ground, pin "7" and a known good engine ground.

Is there any resistance measured?

Yes ➔ Repair faulty wiring.

No ➔ Replace faulty ECM.
DTC 2135 - TPS 1/2 Simultaneous Voltages Out of Range
SPN - 51; FMI - 31

- Throttle Position (TP) Sensor
- Check Condition - Engine cranking
- Fault Condition - Throttle position on TPS1 and TPS2 are greater than 4.80 volts or less than 0.20 volts
- MIL-On during active fault

There are two throttle position sensors located within the throttle body which use variable resistors to determine the signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

This fault will set if the throttle position and redundancy is lost. During this active fault, the MIL will be on and Engine Shutdown is activated.
DTC 2135 - TPS 1/2 Simultaneous Voltages Out of Range
SPN - 51; FMI - 31

Diagnostic Aids

- **For TPS1 Voltage Out of Range** - Troubleshoot according to *DTC 0122 TPS1 Signal Voltage High* and *DTC 0123 TPS1 Signal Voltage Low* procedures.

- **For TPS2 Voltage Out of Range** - Troubleshoot according to *DTC 0222 TPS2 Signal Voltage High* and *DTC 0223 TPS2 Signal Voltage Low* procedures.
• Throttle Control Position (TCP) Sensor
• **Check Condition** - Ignition ON, engine running
• **Fault Condition** - IVS off-idle and TCP voltage less than 0.60 volts
• MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycled

The engine load command to the ECM is determined by operator advancement of the throttle control position (TCP) sensor. The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power that intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch (IVS). Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The IVS is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than idle position.

This fault will set if the IVS is at idle (open) and the TCP1 voltage is less than 0.60 volts.
DTC 2139 - TCP Sensor 1 Lower Than IVS Limit
SPN - 91; FMI - 1

Ignition ON, Engine Running

- Operate engine at idle in neutral.
- Ensure the TCP sensor is securely mounted to the bracket.
- Ensure that the throttle cable is not holding the TCP sensor open and the TCP sensor is in the fully closed throttle position.

Does the DST indicate still indicate a DTC 2131?

Yes

- Ignition OFF.
- Disconnect TCP sensor connector.
- Move TCP sensor to wide open throttle position and hold open.
- Using a DMM, measure the resistance between IVS input signal, pin “8” and IVS ground pin “7” at the TCP connector.

Is the resistance 1K ohms or greater?

Yes

- Using a DMM, measure the resistance between TCP connector IVS ground, pin “7” and a known good engine ground.

Is there any resistance measured?

Yes

- Repair faulty wiring.

No

- Replace faulty ECM.

No

- Intermittent Fault.

Yes

- Replace faulty TCP sensor.

No

- Replace faulty wiring.

ECM0708
DTC 2140 - TCP Sensor 2 Lower Than IVS Limit
SPN - 29; FMI - 1

- Ballast Level / Fuel Level - LINC System
- Check Condition - None
- Fault Condition - None

The camshaft position sensor is a magnetic sensor installed in the distributor on 5.0/5.7L engines adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression).

The cam position, or distributor alignment, must be within 10 degrees of specification. If this position is off by more than the 10 degrees, the MIL will be illuminated and some ignition “cross firing” may occur at certain RPM and load conditions.
DTC 2140 - TCP Sensor 2 Lower Than IVS Limit
SPN - 29; FMI - 1

- Loosen the distributor hold down bolt
- Rotate distributor until the correct CAM Retard is achieved
- Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification

No

Yes

Intermittent Problem

Engine Running

Does DST display CAM Retard within 10 degrees of specification?
DTC 2229 - Barometric Pressure High
SPN - 108; FMI - 0

The camshaft position sensor is a magnetic sensor installed in the distributor on 5.0/5.7L engines adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression).

The cam position, or distributor alignment, must be within 10 degrees of specification. If this position is off by more than the 10 degrees, the MIL will be illuminated and some ignition “cross firing” may occur at certain RPM and load conditions.
Engine Running

Does DST display CAM Retard within 10 degrees of specification?

No

• Loosen the distributor hold down bolt
• Rotate distributor until the correct CAM Retard is achieved
• Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification

Yes

Intermittent Problem

DTC 2229 - Barometric Pressure High
SPN - 108; FMI - 0
The camshaft position sensor is a magnetic sensor installed in the distributor on 5.0/5.7L engines adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression).

The cam position, or distributor alignment, must be within 10 degrees of specification. If this position is off by more than the 10 degrees, the MIL will be illuminated and some ignition “cross firing” may occur at certain RPM and load conditions.
DTC 2618 - TACH Output Short to Ground
SPN - 645; FMI - 4

Engine Running

Does DST display CAM Retard within 10 degrees of specification?

Yes

Intermittent Problem

No

• Loosen the distributor hold down bolt
• Rotate distributor until the correct CAM Retard is achieved
• Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification
• Ballast Level / Fuel Level - LINC System
• Check Condition - None
• Fault Condition - None

The camshaft position sensor is a magnetic sensor installed in the distributor on 5.0/5.7L engines adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression).

The cam position, or distributor alignment, must be within 10 degrees of specification. If this position is off by more than the 10 degrees, the MIL will be illuminated and some ignition “cross firing” may occur at certain RPM and load conditions.
Does DST display CAM Retard within 10 degrees of specification?

- Yes
  - Intermittent Problem
- No
  - Loosen the distributor hold down bolt
  - Rotate distributor until the correct CAM Retard is achieved
  - Tighten down the distributor hold down bolt, verifying that CAM Retard is still at the correct specification

DTC 2619 - TACH Output Short to Power
SPN - 645; FMI - 3