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## Adaptive Fuel Diagnostic Trouble Code (DTC) Diagnostic Techniques

The Adaptive Fuel DTC Diagnostic Techniques help isolate the root cause of the adaptive fuel concern. Before proceeding, attempt to verify if any driveability concerns are present. These diagnostic aids are meant as a supplement to the pinpoint test steps in Section 5. For a description of fuel trim, refer to Section 1, [Powertrain Control Software](#), Fuel Trim.

### Obtain Freeze Frame Data

Freeze frame data is helpful in duplicating and diagnosing adaptive fuel concerns. The data (a snapshot of certain parameter identification (PID) values recorded at the time the DTC is stored in Continuous Memory) is helpful to determine how the vehicle was being driven when the concern occurred, and is especially useful on intermittent concerns. Freeze frame data, in many cases, helps to isolate possible areas of concern as well as rule out others. Refer to [Freeze Frame Data](#) in this section for a more detailed description of this data.

### Using the LONGFT1 and LONGFT2 (Dual Bank Engines) PIDs

The LONGFT1/2 PIDs are useful for diagnosing fuel trim concerns. A negative PID value indicates that fuel is being reduced to compensate for a rich condition. A positive PID value indicates that fuel is being increased to compensate for a lean condition. It is important to know that there is a separate LONGFT value that is used for each RPM/load point of engine operation. When viewing the LONGFT1/2 PIDs, the values may change a great deal as the engine is operating at different RPM and load points. This is because the fuel system may have learned corrections for fuel delivery concerns that can change as a function of engine RPM and load. The LONGFT1/2 PIDs display the fuel trim currently being used at that RPM and load point. Observing the changes in LONGFT1/2 can help when diagnosing fuel system concerns. For example:

- A contaminated mass air flow (MAF) sensor results in matching LONGFT1/2 correction values that are negative at idle (reducing fuel), but positive (adding fuel) at higher RPM and loads.
- LONGFT1 values that differ greatly from LONGFT2 values rule out concerns that are common for both banks (for example, fuel pressure concerns, MAF sensor, etc. can be ruled out).
- Vacuum leaks result in large rich corrections (positive LONGFT1/2 value) at idle, but little or no correction at higher RPM and loads.
- A plugged fuel filter results in no correction at idle, but large rich corrections (positive LONGFT1/2 value) at high RPM and load.

### Resetting Long Term Fuel Trims

Long term fuel trim corrections are reset by resetting the keep alive memory (KAM). Refer to [Resetting The Keep Alive Memory \(KAM\)](#) in this section. After making a fuel system repair, reset the KAM. For example, if dirty/plugged injectors cause the engine to run lean and generate rich long term corrections, installing new injectors and not resetting the KAM causes the engine to run very rich. The rich correction eventually leans out during closed loop operation, but the vehicle may have poor driveability and high carbon monoxide (CO) emissions while it is learning.

### DTCs P0171/P0174 System Too Lean Diagnostic Aids

**Note:** If the system is lean at certain conditions, then the LONGFT PID would be a positive value at those conditions, indicating that increased fuel is needed.

The ability to identify the type of lean condition causing the concern is crucial to a correct diagnosis.

### Air Measurement System

With this condition, the engine runs rich or lean of stoichiometry (14.7:1 air/fuel ratio) if the powertrain control module (PCM) is not able to compensate enough to correct for the condition. One possibility is that the mass of air entering the engine is actually greater than what the MAF sensor is indicating to the PCM. For example, with a contaminated MAF sensor, the engine runs lean at higher RPM because the PCM delivers fuel for less air than is actually entering the engine. Examples:

- The MAF sensor measurement is inaccurate due to a corroded connector, contaminated or dirty connector. A contaminated MAF sensor typically results in a rich system at low airflows (PCM reduces fuel) and a lean system at high airflows (PCM increases fuel).

### **Vacuum Leaks/Unmetered Air**

With this condition, the engine runs lean of stoichiometry (14.7:1 air/fuel ratio) if the PCM is not able to compensate enough to correct for the condition. This condition is caused by unmetered air entering the engine, or due to a MAF sensor concern. In this situation, the volume of air entering the engine is actually greater than what the MAF sensor is indicating to the PCM. Vacuum leaks are normally most apparent when high manifold vacuum is present (for example, during idle or light throttle). If freeze frame data indicates that the concern occurred at idle, a check for vacuum leaks/unmetered air is the best starting point. Examples:

- loose, leaking, or disconnected vacuum lines
- intake manifold gaskets, or O-rings
- throttle body gaskets
- brake booster
- air inlet tube
- stuck/frozen/aftermarket positive crankcase valve (PCV)
- unseated engine oil dipstick

### **Insufficient Fueling**

With this condition, the engine runs lean of stoichiometry (14.7:1 air/fuel ratio) if the PCM is not able to compensate enough to correct for the condition. This condition is caused by a fuel delivery system concern that restricts or limits the amount of fuel being delivered to the engine. This condition is normally apparent as the engine is under a heavy load and at high RPM, when a higher volume of fuel is required. If the freeze frame data indicates that the concern occurs under a heavy load and at higher RPM, a check of the fuel delivery system (checking fuel pressure with engine under a load) is the best starting point. Examples:

- low fuel pressure (fuel pump, fuel filter, fuel leaks, restricted fuel supply lines)
- fuel injector concerns

### **Exhaust System Leaks**

In this type of condition, the engine runs rich of stoichiometry (14.7:1 air/fuel ratio) because the fuel control system is adding fuel to compensate for a perceived (not actual) lean condition. This condition is caused by the heated oxygen sensor (HO2S) sensing the oxygen (air) entering the exhaust system from an external source. The PCM reacts to this exhaust leak by increasing fuel delivery. This condition causes the exhaust gas mixture from the cylinder to be rich. Examples:

- exhaust system leaks upstream or near the HO2S
- cracked/leaking HO2S boss
- inoperative secondary air injection system

### **DTCs P0172/P0175 System Too Rich Diagnostic Aids**

**Note:** If the system is rich at certain conditions, then the LONGFT PID would be a negative value at that airflow, indicating that decreased fuel is needed.

System rich concerns are caused by fuel system concerns, although the MAF sensor and base engine (for example, engine oil contaminated with fuel) should also be checked.

### **Air Measurement System**

With this condition, the engine runs rich or lean of stoichiometry (14.7:1 air/fuel ratio) if the PCM is not able to compensate enough to correct for the condition. One possibility is that the mass of air entering the engine is actually less than what the MAF sensor is indicating to the PCM. For example, with a contaminated MAF sensor, the engine runs rich at idle because the PCM delivers fuel for more air than is actually entering the engine. Examples:

- MAF sensor measurement inaccurate due to a corroded connector, contamination/dirt. A contaminated MAF sensor typically results in a rich system at low airflows (PCM reduces fuel) and a lean system at high airflows (PCM increases fuel).

## **Fuel System**

With this condition, the engine runs rich of stoichiometry (14.7:1 air/fuel ratio), if the PCM is not able to compensate enough to correct for the condition. This situation causes a fuel delivery system that is delivering excessive fuel to the engine.

Examples:

- fuel pressure regulator (mechanical returnless fuel systems) causes excessive fuel pressure (system rich at all airflows), fuel pressure is intermittent, going to pump deadhead pressure, then returning to normal after the engine is turned off and restarted.
- fuel injector leaks (injector delivers extra fuel).
- EVAP canister purge valve leak (if the canister is full of vapors, introduces extra fuel).
- fuel rail pressure (FRP) sensor (electronic returnless fuel systems) concern causes the sensor to indicate a lower pressure than actual. The PCM commands a higher duty cycle to the fuel pump driver module (FPDM), causing high fuel pressure (system rich at all airflows).

## **Air Inlet System**

A restriction within any of the following components may be significant enough to affect the ability of the PCM adaptive fuel control.

- air inlet tube
- air cleaner element
- air cleaner assembly
- resonators
- clean air tube

## **Base Engine**

Engine oil contaminated with fuel can contribute to a rich-running engine.

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