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 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 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 and LONGFT2 PIDs are useful for diagnosing fuel trim concerns. A negative PID value indicates fuel is being reduced to compensate for a rich condition. A positive PID value indicates fuel is being increased to compensate for a lean condition. It is important to know there is a separate LONGFT value used for each RPM and load point of engine operation. When viewing the LONGFT1 and LONGFT2 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 and LONGFT2 PIDs display the fuel trim currently being used at that RPM and load point. Observing the changes in LONGFT1 and LONGFT2 can help when diagnosing fuel system concerns. For example:

- A contaminated mass airflow (MAF) sensor results in matching LONGFT1 and LONGFT2 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 and LONGFT2 values) 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 and LONGFT2 values) 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 or 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 and 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 diagnosis.

Air Measurement System

With this condition, the engine runs rich or lean of stoichiometry 14.7 to 1 (9 to 1 E100) air to fuel ratio, if the PCM is not able to compensate enough to correct for the condition.

For example, 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 and Unmetered Air

With this condition, the engine may actually run lean of stoichiometry 14.7 to 1 (9 to 1 E100) air to fuel ratio, if the PCM is not able to compensate enough to correct for the condition. This condition can be caused by unmetered air entering the engine. Vacuum leaks normally are most apparent when high manifold vacuum is present (for example, during idle or light throttle). If freeze frame data indicates the fault occurred at idle, a check for vacuum leaks and unmetered air might be the best starting point.

For example, loose, leaking or disconnected vacuum lines, intake manifold gaskets or O-rings, throttle body gaskets, brake booster, air inlet tube or unseated engine oil dipstick.

Insufficient Fueling

With this condition, the engine runs lean of stoichiometry 14.7 to 1 (9 to 1 E100) air to 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 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 of this include:

- 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 to 1 (9 to 1 E100) air to 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 of this include:

- exhaust system leaks upstream or near the HO2S
- cracked or leaking HO2S boss

DTCs P0172 and 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 to 1 (9 to 1 E100) air to fuel ratio, if the PCM is not able to compensate enough to correct for the condition.

Fuel System

With this condition, the engine runs rich of stoichiometry 14.7 to 1 (9 to 1 E100) air to 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 of this include:

- 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).
- evaporative emission (EVAP) purge valve leak (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 control module, causing high fuel pressure (system rich at all airflows).

Intake Air System

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

Base Engine

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