Mighty On the Line

Lean Fuel Trim Codes

They Can Challenge the Experienced Technician

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The 2013 Ford F150 equipped with a 3.5L EcoBoost engine was running perfectly. With the exception of a drop in fuel economy, there was no indication of a problem until the Check Engine light in the dash illuminated. A system scan revealed P2098 code stored in memory, which represents Post Catalyst Fuel Trim System Too Lean Bank 2. The location of Bank 2 is the opposite side of number one cylinder, which in this case would be the driver's side bank of cylinders.

The PCM monitors the correction value from the down-stream heated oxygen sensor as a part of the fore-aft oxygen sensor control routine. The P2098 code sets when the correction value is greater than a calibrated limit. When this condition occurs, possible causes include:

1) Oxygen sensor terminal corrosion
2) Poor connections
3) Exhaust leaks allowing unmetered up-stream air to enter resulting in a false oxygen sensor reading
4) Contaminated oxygen sensor Bank 2 Sensor 1
5) Vacuum leaks
6) Low fuel pressure
7) Fuel injectors

Later in the article we will add an additional step to the above checks, which was the solution.

It's human nature to go for the quick fix first, especially when the symptoms fit a pattern of failures. The up-stream oxygen sensor is usually the first component that gets replaced and it often resolves the symptoms. In this case, considering the vehicle had 105K town driven miles on the oxygen sensors, both the upstream and downstream sensors were replaced on that bank. Unfortunately, this did not eliminate the symptom, as the Check Engine light returned following a few drive-cycles.

Exhaust Leaks

While there were no audible sounds due to an exhaust leak, further testing was performed to rule out the introduction of outside/unmetered air entering the system, resulting in the lean symptom. A minute air leak can play havoc with the system and set lean fuel trim codes.

Further testing involved pressurizing the exhaust system with air pressure and checking for leaks by spraying the connections with a soapy solution. Pressurizing the exhaust system can be performed with compressed air in the 8-10 psi range maximum at the tail pipe. Another option is attaching the exhaust port of a shop vacuum to the tail pipe with duct tape. This means will provide sufficient pressure for the soapy solution test. In this case no leaks were present.

Vacuum Leaks

For those with good hearing, vacuum leaks may not be a challenge. If your ears ring constantly due to damage from noises emitted from a supercharged direct drive drag boat while straddling a spur cut gear box emitting a high pitched whine, you will never hear a vacuum leak.

My personal vacuum leak tester is comprised of a small propane bottle with a rubber hose attached. Any vacuum leak will be evidenced by an increase in engine RPM as the propane is introduced. Do not let the propane come in contact with any electrical arc, or else you may smell funny for the weekend.

Sensitive Sensors

The 3.5L EcoBoost was fitted with a speed density means of fuel control. The system is comprised of three sensors:

1) Turbocharger Intake Pressure and Temperature (TCIPT) Sensor
2) Turbocharger Boost Pressure (TCBP)/ Charge Air Cooler Temperature (CACT) Sensor
3) Manifold Absolute Pressure (MAP)/Intake Air Temperature 2 (IAT2) Sensor

The Cure for the Lean Fuel Trim Code P2098

While no sensor codes were stored in memory, each of the three previously mentioned sensors were removed for inspection purposes. That inspection revealed that the Turbocharger Boost Pressure (TCBP)/Charge Air Cooler Temperature (CACT) Sensor and the Manifold Absolute Pressure (MAP)/Intake Air Temperature 2 (IAT2) Sensor were both contaminated with a light film of oil.

A clean-up of the two mentioned sensors with a Mass Air Flow sensor cleaner was all it took to restore the fuel economy and eliminate the P2098 Bank 2 Lean Fuel Trim code. The ultimate solution was misleading, as we assumed a sensor failure or contamination would have set a code plus a lean trim code on both banks of cylinders, but that was not the case.