Fuel Trim can be a Valuable Diagnostic Tool

If you are trying to diagnose drivability issues but don’t have any trouble codes to chase, take a closer look at the vehicle’s “fuel trim.” When analyzed properly, it can be a valuable diagnostic tool, a window to the heart of the Fuel control system and how it is operating.

Understanding Fuel Trim

A vehicle’s computer system uses Fuel Trim to help maintain the ideal air/fuel ratio for complete combustion (stoichiometry) – 14.7 parts air to 1 part fuel. Three-way Catalytic converters need the mixture to be constantly driven rich/lean around this ratio in order to work at maximum efficiency. Fuel trims can compensate for other vehicle issues. That’s why fuel trims are so useful. They can provide an overall picture of what is causing the problem such as an intake manifold vacuum leak (positive fuel trim – lean) or a stuck open fuel injector (negative fuel trim – rich).
Short Term Fuel Trim

Short Term Fuel Trim (STFT1 and STFT2) is the computer’s immediate response to adjust the air/fuel ratio. In positive corrections, fuel is added to adjust for a lean condition, while negative corrections respond to a rich condition. STFT corrections represent the current engine run cycle and react very quickly to O2 sensor input. If you were to create a large vacuum leak at Idle by disconnecting the PCV hose, the computer would immediately add positive fuel trim to balance the mixture. Short Term Fuel Trim is not stored in Keep Alive Memory (KAM) after shut down and automatically resets to 0 for the next start/run cycle.

Long Term Fuel Trim

Unlike STFT, Long Term Fuel Trim (LTFT1 and LTFT2) is learned over time while in closed loop operation. It is stored in the KAM and used for open loop fuel calculations (like start up and wide-open throttle). LTFT is a coarser adjustment and also works to keep STFT within specification.

Diagnosis with Fuel Trims

Fuel trims can help you zero in on the problem, especially when there are no other trouble codes present. Knowing whether a vehicle is running too rich or too lean will help narrow down your diagnosis. Fuel trims that differ greatly from one-cylinder bank to the other will also point you in the right direction. Always evaluate fuel trims at idle and at 2500 RPM.

Running too rich – High negative fuel trim corrections can be caused by MAF sensor problems, high fuel pressure, leaking fuel pressure regulator diaphragm, faulty evaporative emissions components, leaking injectors, defective O2 sensors, exhaust leaks/pinholes before the O2 sensor, coolant temp sensor problems, and base engine issues such as low compression and incorrect camshaft timing.

Running too lean – High positive fuel corrections can be traced to MAF and O2 sensor faults, vacuum leaks from intake gaskets/hoses, unmetered air (intake snorkel leak), clogged or dirty fuel injectors, fuel delivery issues, and exhaust restrictions such as a clogged catalytic converter.
Diagnostic Tip:

For a suspected vacuum leak, note the fuel trims at idle and increase engine speed to 2500 RPM and hold. If the STFT immediately decreases and moves to acceptable levels and the LTFT slowly starts to come back down, you have a vacuum leak. After the repair, reset the KAM and start the vehicle. Monitor the fuel trims to make sure they are within the normal ranges. It could take up to 10 miles of driving for an accurate LTFT reading.