

System and Component Monitors

Heated Oxygen Sensor Monitor

OBD II regulations require monitoring of the upstream heated oxygen sensors to detect when deterioration of the sensor has exceeded emission thresholds. Additional oxygen sensors are located downstream to determine the efficiency of the catalyst. The downstream sensors are of a different type to those used for fuel control. The front and rear sensors are not interchangeable. They are monitored to determine if a voltage is generated. That voltage is then compared to values in memory to determine if the catalyst efficiency is in range.

Operation

The fuel control system attempts to maintain an air/fuel ratio of approximately 14.7:1. The PCM uses the input from the upstream HO2S sensors to fine tune the air fuel mixture.

The upstream heated oxygen sensors are mounted in the exhaust flow between the engine and the catalytic converters. The sensors operate between zero and one volt output depending on the oxygen content of the exhaust gasses. Lean air/fuel mixture will cause a sensor voltage of 0 - 0.4 volts. Rich air/fuel mixture will cause a voltage of 0.6 - 1.0 volts. The ideal air/fuel mixture would cause a sensor voltage of 0.4 - 0.6 volts to be generated. The actual sensor voltage will fluctuate as the system attempts to reach optimum air/fuel mixture under constantly changing conditions.

The following HO2S system checks are performed:

Upstream sensors are checked by changing the air fuel ratio and monitoring the sensor response.

Downstream sensors are monitored by noting the voltage change for changes in downstream oxygen content.

All sensors are monitored for overvoltage conditions

Sensor heaters are checked by turning them on and off and looking for changes in the current they draw.

When a HO2S malfunction is detected for two drive cycles, the DTC is stored in memory and the MIL is turned on. The MIL will be turned off after three consecutive trips without the same malfunction being detected, providing that no other malfunctions are present which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Catalyst Efficiency Monitor

The catalyst efficiency monitor determines when the catalyst efficiency has fallen below the minimum efficiency requirements.

Operation

Upstream and downstream oxygen sensor signals are compared during a range of speed/load conditions. The catalyst must be able to process the exhaust gases such that the rear oxygen sensors are prevented from switching in the same way as the front.

When a catalyst efficiency malfunction is detected for two drive cycles, the DTC is stored in memory and the MIL is turned on. The MIL will be turned off after three consecutive trips without the same malfunction being detected, providing that no other malfunctions are present which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset or a DTC 'CLEAR' using WDS.

Fuel System Monitor

The fuel system monitor is a self test strategy within the PCM that monitors the adaptive fuel table. This table is used by the fuel control system to compensate for normal variability of the fuel system components due to age or wear. If the fuel system appears biased lean or rich, the adaptive fuel values will be shifted to remove the bias.

Operation

The adaptive fuel system uses the upstream oxygen sensor outputs as its primary input. The system also is capable of adapting fuelling requirements based on, Air Temperature, Coolant Temperature and Mass Air Flow.

As the fuel control and air metering components age or vary from nominal values, the adaptive fuel strategy learns corrections while in closed loop operation. These corrections are stored in a table called 'Long Term Fuel Trim'. The table resides in KAM (Keep Alive Memory) and is used to correct fuel delivery while in open or closed loop control.

As components continue to change, the table will reach its adaptive limit and can no longer cope with additional changes in fuelling components. Further changes in the fuel system components will cause deviation in the closed loop parameter called 'Short Term Fuel Trim'. As this deviation in short term fuel trim approaches 1.5 times the applicable standard, fuel/air control suffers and emissions may increase. At this point, a fuel system fault is declared and a DTC is stored.

The fuel system tests are only run when the following preconditions are satisfied, engine rpm within acceptable range, air mass within calibrated limits, engine coolant temperature indicates the engine fully warmed up, steady throttle opening at a road speed of 30 - 45 m.p.h. Idle and deceleration performances are excluded from fuel system testing.

In the fuel system monitor, when a malfunction has been present for two drive cycles, the DTC is stored and the MIL lamp is turned on. At the same time, freeze frame data will be stored as described in the system overview. In order to provide the maximum information for fault analysis, the range of freeze frame data stored when a fuel system monitor fault occurs exceeds that required by the Air Resources Board.

The MIL is turned off after three consecutive drive cycles without the same DTC being detected provided that no other DTCs are recorded which would independently turn on the MIL. The DTC will be erased from memory after 40 trips provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Purge System Monitor

Tests the integrity and operation of the evaporative loss purge system.

Operation

Primary PCM - After an overnight soak, during steady state driving, the canister vent valve is closed and the purge system pulls a light vacuum in the fuel tank. The time taken for the vacuum to decay is measured and compared to calibrated limits. The results indicate whether the fuel vapour system is leak proof.

Secondary PCM - During vehicle acceleration, the engine fuelling requirements are stabilised and then the vapour management valve is opened. If the carbon canisters contain fuel vapour, it will be drawn into the inlet manifold. The fuelling correction required to rectify the fuel imbalance caused by the additional fuel vapour is noted. The adjustment required is used as an indicator of correct purge system flow.

Misfire Detection Monitor

Misfire is defined as the lack of proper combustion in the cylinder due to the absence of spark, poor fuel metering or poor compression. Any combustion occurring at an improper time is also defined as a misfire.

Misfires are detected by the Neural Net Misfire Monitor which checks various engine operating conditions (particularly crankshaft acceleration) and compares them to data held in PCM memory.