P1336 will set. This DTC indicates that noise is present on the crank sensor input or there is a lack of synchronization between the camshaft and crankshaft sensors.

Low Data Rate (LDR) System

The LDR misfire monitor uses a low data rate CKP sensor signal which indicates one time measurement signal for each cylinder event. The PCM uses the CKP sensor signal to calculate the crankshaft speed and acceleration for each cylinder. The crankshaft acceleration is then processed to detect a sporadic, single-cylinder misfire patterns or multi-cylinder misfire patterns. The changes in overall engine RPM are removed by subtracting the median engine acceleration over a complete engine cycle. The crankshaft acceleration is then processed by three algorithms. The first algorithm, called pattern cancellation, is optimized for detection of sporadic patterns of misfire. The algorithm learns the normal pattern of cylinder accelerations from the mostly good firing events and is then able to accurately detect deviations from that pattern. The second algorithm, called pattern cancellation by opposing engine revolution, is optimized for single cylinder patterns. The algorithm compares the acceleration of a cylinder to its opposite cylinder on the opposing engine revolution. The algorithm learns the normal patterns that repeat every engine revolution and is then able to accurately detect deviations between the paired cylinders. The third algorithm is a non filtered acceleration signal that is a general purpose signal for all patterns including multi cylinder patterns. The resulting deviant cylinder acceleration values are used in evaluating misfire. Refer to the General Misfire Processing in this section for more information.

High Data Rate (HDR) System

The HDR misfire monitor uses a high data rate CKP sensor signal which indicates 60 position references per crankshaft revolution. This high resolution signal is processed with a digital low pass filter. The low pass filter filters the high resolution crankshaft velocity signal to remove some of the crankshaft torsional vibrations that degrade signal to noise. Two low pass filters are used to enhance detection capability: a base filter and a more aggressive filter to enhance single cylinder capability at higher RPM. This significantly improves detection capability for continuous misfires on single cylinders up to red line. The changes in overall engine rpm are removed by subtracting the median engine acceleration over a complete engine cycle. The crankshaft acceleration is then processed by three algorithms similar to the LDR system. The final stage is to decimate the high resolution signals by selecting the peak acceleration values from within a window location for each cylinder. The resulting deviant cylinder acceleration values are used in evaluating misfire. Refer to the General Misfire Processing in this section for more information.

General Misfire Processing

The acceleration that a piston undergoes during a normal firing event is directly related to the amount of torque that cylinder produces. The calculated piston and cylinder acceleration values are compared to a misfire threshold that is continuously adjusted based on inferred engine torque. Deviant accelerations exceeding the threshold are conditionally labeled as misfires. The cold start emission reduction (CSER) monitor uses a threshold multiplier during startup to compensate for the reduction in the signal amplitude during ignition spark retard conditions. The threshold adjustments may also be applied to compensate for torque reduction during gear shift events, and to compensate for changes in driveline coupling with torque convertor lock status.

The calculated deviant acceleration values are also evaluated for noise. Normally, misfire results in a nonsymmetrical loss of cylinder acceleration. Mechanical noise, such as rough roads or crankshaft oscillations at low rpm or high load conditions, will produce symmetrical positive acceleration variations. Noise limits are calculated by applying a negative multiplier to the misfire threshold. If the noise limits are exceeded, a noisy signal condition is inferred and the misfire monitor is suspended for a brief interval. Noise free deviant acceleration exceeding a given threshold is labeled a misfire.

On some vehicles with 4 cylinder engines, the signals are also evaluated for noise from mechanical resonance in the transmission hardware at low load conditions. This mechanical noise can produce acceleration variations that are indistinguishable from a paired cylinder misfire pattern. The software includes a check of the universal heated oxygen sensor (HO2S) signal when a paired cylinder misfire pattern is present. Normally, there will be a lean shift on the HO2S if 2 out of the 4 cylinders are misfiring. If the HO2S does not indicate lean, a noisy signal condition is inferred and the misfire monitor is suspended while the conditions are present.

The number of misfires are counted over a continuous 200 revolution and 1,000 revolution period. The revolution counters are not reset if the misfire monitor is temporarily disabled such as for negative torque mode. At the end of the evaluation period, the total misfire rate and the misfire rate for each individual cylinder is computed. The misfire rate is evaluated every 200 revolution period (Type A) and compared to a threshold value achieved from an engine speed and load table. This misfire threshold is designed to prevent damage to the catalyst due to sustained excessive temperature 899°C (1,650°F) for Pt/Pd/Rh advanced washcoat and 982°C (1,800°F) for Pd-only high tech washcoat. If the misfire threshold is exceeded and the catalyst temperature model calculates a catalyst mid-bed temperature that exceeds the catalyst damage threshold, the MIL blinks at a 1 Hz rate while the misfire is present. If the threshold is again exceeded on a subsequent driving cycle, the MIL is illuminated.