

**Mass Air Flow Sensor (X105)**

The sensing element of a Mass Air Flow Sensor (X105) is a “hot wire anemometer” consisting of one heated wire. The air flows across the hot wire, cooling the wire and thereby altering its resistance. The ECM (Z132) measures this change in resistance and so calculates the amount of air flowing into the engine.

If the Mass Air Flow Sensor (X105) fails, the engine will start and then die as the engine reaches 550 rpm before the ECM (Z132) looks for the Mass Air Flow Sensor (X105) signal.

**Throttle Position Sensor (X171)**

This sensor is a variable resistor. The signal informs the ECM (Z132) of the actual position of the throttle plate. Failure of the Throttle Position Sensor (X171) will result in poor idle and lack of throttle response. If the Throttle Position Sensor (X171) fails in the “closed” mode, then the engine will only rev up to 1740 rpm when the ECM (Z132) will initiate “over run fuel cut–off”.

**Heated Oxygen Sensors (X139, X160, X289, X290)**

The heated oxygen sensor consists of a titanium metal sensor surrounded by a gas–permeable ceramic coating. Oxygen in the exhaust gas diffuses through the ceramic coating on the sensor and reacts with the titanium wire, altering the resistance of that wire. From this change in resistance, the ECM (Z132) can calculate the percentage of oxygen in the exhaust gas and adjust the injected fuel quantity that as to achieve the correct air/fuel ratio. This reduces the emissions of Carbon Monoxide (CO), Hydrocarbons (HC) and oxides of Nitrogen (NOX) to acceptable levels.

Presently, two heated oxygen sensors are used, one in each exhaust down pipe just before the catalyst.

In the event of sensor failure, the system will default to “open loop”. Operation and fuelling will be calculated using signals from the remaining ECM inputs. The fault is indicated by illumination of the malfunction indicator lamp (MIL). ECM diagnostics also uses heated oxygen sensors to detect catalyst damage, misfire and fuel system faults.

North American vehicles have two extra heated oxygen sensors mounted one after each catalyst. These are used to determine whether the catalysts are operating efficiently.

**Idle Air Control Valve (M112)**

The Idle Air Control Valve (M112) controls the idle speed of the engine by moving the plunger a set distance, known as a step. Fully open is 200 steps and fully closed is 0 steps. The motor moves each step by sequentially changing the polarity to each of the two coils.