Lambda Sensors

To optimise combustion, advanced engine control systems need fast, accurate and reliable information about the air/fuel ratio (or lambda) in the exhaust. This guarantees that the engine is operated most efficiently, and gives the most power, under all driving conditions.

McLaren Electronic Systems offer the NGK UEGO (Universal Exhaust Gas Oxygen) Sensor for this precision task as it has proven its performance and reliability in all of our engine control applications.

Principle of Operation

The Universal Air-Fuel Ratio (AFR) Heated Exhaust Gas Oxygen (UEGO) sensor has been developed to measure a wide range of air/fuel mixtures. (Note: lambda is 1 when AFR is 14.57 which is the stoichiometric mixture based on propane fuel).

The UEGO sensor is based on Zirconium Dioxide cells, which are held at an elevated temperature by an internal heater. The sensor has two cavities: one for sensing and one for reference. The sensing cavity is linked to the exhaust gas by a diffusion aperture and the reference cavity is linked to the sensing cavity by a much smaller aperture. A small, constant pumping current transfers oxygen from the sensing cavity to the reference cavity. A second pumping current pumps oxygen between the sensing cavity and the exhaust in order to maintain a constant reference cell oxygen concentration. The measured value of this current gives the air/fuel ratio (AFR).

When measuring lean mixtures, excess oxygen in the exhaust diffuses into the sensing cavity. This leads to an increase in the oxygen concentration in the reference cavity which is brought back to its fixed level by adjusting the measured pump current to transfer oxygen from the sensing cavity back to the exhaust gas. The measured value of the pump current indicates the amount of excess oxygen in the exhaust.

Rich mixtures result in an increase of carbon monoxide and hydrogen being diffused into the sensing cavity. From there they diffuse into the reference cavity, where they deplete the oxygen concentration. The measured pump current is adjusted to pump oxygen from the exhaust into the reference cavity to restore the oxygen level. The current required to do this is a measure of the concentration of carbon monoxide and hydrogen.

Use with Engine Control Units

The accuracy of UEGO sensors is extremely high at an exact stoichiometric burn, i.e. when the pumping current is zero. For non-stoichiometric conditions, the pump current can vary by up to ±15% between otherwise identical sensors. These variations can be compensated for using the calibration data supplied with each sensor.

For maximum accuracy, each sensor is calibrated at two lambda values, 0.75 and 1.25. The calibration data is available in computer readable form and can be loaded into any of our systems. Our measurement system uses the calibration data to compensate for any given sensor slope, at lean and rich values of lambda, between the calibration points for a specified fuel type.

The UEGO sensors can be connected directly to our Engine Control Units (ECUs) TAG-400, TAG-300 and TAG-210. If your ECU does not include a built in interface for this probe, then you can add our lambda measurement sensor node, SN-32LT.

The sensor must be powered up when the engine is running so that the heater will maintain the minimum operating temperature. If the operational temperature is exceeded, sensor function will be impaired, causing large calibration errors, as well as possible heater element damage. The UEGO sensor is not resistant to temperature shocks, so it should not be subjected to cold-fluid cooling or similar.

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