FACT SHEET. Lambda Sensors.

- **Introduction**

There are many confusing and conflicting papers surrounding lambda sensors and their functionality. This fact sheet is written to summarise the various current types of sensors, how they work, how to identify the differing wire colours, which ones Facet s.r.l offer then a brief overview of some external factors affecting their performance.

- **History**

Oxygen sensors have been with us since the mid 1970's, development and subsequent improvements have changed dramatically since then, this is a direct result of the enhanced electronic circuitry used in controlling the overall fuel delivery system in modern day vehicles.

- **Development Stages**

Lambda sensors began with just one wire, and a threaded ground connection, a second direct ground wire was then added due to corrosion around the sensor to the exhaust area. Since it was known that the sensor only became functional at 600 degrees Fahrenheit, a third pre-heater wire was added. Today most sensors have four wires; -

1) A signal wire, usually **black** in colour
2) A dedicated ground wire, **grey** or white in colour
3) Positive & negative battery voltage, pre-heater wires, usually white in colour.

Some current sensors are now being produced with five or even eight wires; we shall discuss these briefly in the next section.

- **Types & Technology**

The oxygen sensor looks like a spark plug and is located in the exhaust manifold before the catalyst. It operates as part of the 'closed loop' control system and monitors oxygen content within the exhaust emissions to provide data for the ECU. This allows control of the air/fuel ratio to a level within which the catalytic converter is able to function correctly. There are two main types in use today, Zirconia and Titania sensors;

Zirconia sensors

These sensors have a 'tip' made from a ceramic called zirconium oxide, which is able to detect and conduct oxygen ions in the exhaust gases. This material along with platinum electrodes and a heater make up today's zirconia sensors.

The outside of this coated ceramic tip is exposed to the oxygen in the exhaust system. The inner part is vented to detect oxygen contained in the atmosphere. The difference between these two points causes the oxygen sensor to generate a voltage.

The zirconia lambda, operates between 0.1 & 1.1 volts, when the ECU reads a 'cross count' voltage below 0.45V, it regards this as lean and lets more fuel through the injectors, the reverse occurs in rich conditions over 0.45V.
There is a transition time involved with this process, therefore the more 'cross counts' (responses) the sensor makes the more efficient the vehicles fueling and emissions become.

There are two main types of tip technology used either a 'thimble' type or a 'thick film, planar' type, the 'thick film' sensors are most common and employ a greater heater resistance to speed up the sensors operation.

Five wire sensors are now being fitted to later model cars, these are know as 'wide-band, 'lean-burn' sensors. In essence instead of using the 'cross count' average voltage these are able to measure the air/fuel ratio precisely and produce a voltage signal directly proportional to this ratio, which results in more accurate emissions control. These are not currently produced by Facet.

Titania sensors
These are made from titanium dioxide, and differ from the zirconia lambda by NOT being able to produce a 'self voltage'. The engine ECU supplies a base voltage of approximately 1 volt to the sensor; the resultant voltage flowing through the sensor is read by the ECU to measure the air/ fuel ratio based on resistance. Obviously as the technology involved here is different from Zirconia sensors, THE TWO MUST NOT BE INTERCHANGED.

Identification of; -
Titania sensors are either 3 or 4 wire there are three main types.

1) 3 wire, 12mm thread with a **Black** (ref. out) **Red** (heater + & ref. in) and White (heater -) set of wires.
2) 3 wire, 18mm thread with **Black**, **Red** & White wires.
3) 4 wire, 18mm thread, **Black** (ref. out) **Red** (heater +) White (heater -) & **Yellow** (ref. in)

Facet Lambda Sensors.

All Facet oxygen sensors are the Zirconia type; we **do not** currently make any Titania sensors. Our range is broken down into two distinct categories, Universal and Direct Fit type sensors;

- **Universal Type.**

a) **1 Wire**: one version only (10.7001) with its ground on the units' body, no heater.

b) **2 Wire**: one version only (10.7002) with ground on the body and no heater.

c) **3 Wire**: two versions, 10.7003, this has a ground on the body and a 4 OHM heater. 10.7005 is the same however the heater is 7 OHM.

d) **4 Wire**: four versions;
10.7004 has a ground on the body and a 4-OHM heater.
10.7006 has a ground on the body and a 7-OHM heater.

10.7007 has a dedicated ground connection and a 4-OHM heater.
10.7008 has a dedicated ground connection and a 7-OHM heater.

By referring to Facet UK or by using Facet s.r.l's website, www.facet.it the above universal lambda's can replace most of our range of direct fit sensors.

- **Direct Fit Type.**

The majority of oxygen sensors produced by Facet are the 'direct fit' type, these as the name suggests replace the OE unit originally fitted, without the need to cut and 'crimp' any wiring.

These types of sensors are obviously a more efficient product as they save valuable man-hours in fitment and due to their design are more likely to provide accurate readings to the vehicle ECU.

NB: as with all Facet products, it is essential to follow our published application guide, failure to do so will invalidate any associated warranty claim.

Universal type.

Direct fit type.

- **Lambda; external influences**

The following points should be considered when dashboard lights or codes show a potential lambda failure;

1) A simple cracked ceramic in a spark plug will result in a misfire; this constant misfire will allow unburned fuel to reach the oxygen sensor, coating it, and then creating a unit failure. The failed sensor will give incorrect information to the ECU that may result in further unburned fuel reaching the catalytic converter, eventually creating the failure of that unit. Costly repairs will be needed simply due to a single spark plug failure allowing unburned oxygen to enter into the exhaust, causing the lambda to give a false lean indication.

2) Engine air leaks in the intake or exhaust manifold can have an affect on the accuracy of the lambda sensor.

3) Excessive hydrocarbon (HC) and carbon monoxide (CO) emissions, poor fuel mileage, rough idle and a loss of power are prime indications of a sluggish or static oxygen sensor. Drivability problems such as engine surging or hesitation can be attributed to a failing oxygen sensor.

4) If the average voltage from the sensor remains high (more than 0.5v), the prime indication is a rich condition possibly due to a bad M.A.P, M.A.F or airflow sensor or a leaky fuel injector.
   If the average voltage reading is a steady low (less than 0.45v) the air/fuel mixture is running lean possibly due to a vacuum leak or the fact that the lambda sensor itself has failed completely.