ECProbe

MODEL



In-Situ Carbon Probe for Carbon Control Systems

Specification Sheet

The ECProbe unique and patented design features a cylinder of special zirconium oxide formulation welded into the end of an alumina tube by means of a eutectic welding process - the resultant homogenous structure provides a very robust design. The probe sheath is a high temperature special alloy with a flow through tip design to minimise soot collection. External connections are made with a quick disconnect plug.

The probe can measure very low oxygen partial pressures with extreme accuracy and repeatability. It will control furnace atmospheres and gas generators over a full range of carburising and hardening applications.

Works in all common reducing atmospheres:

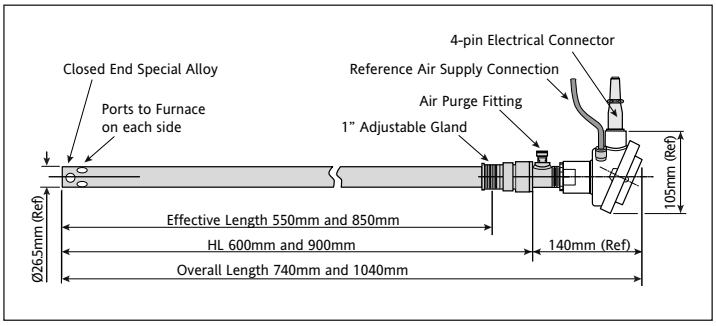
- **Endothermic**
- **Nitrogen/methanol**
- **Nitrogen/natural gas**
- **Nitrogen/hydrogen**
- **Nitrogen/propylene**

Features

- **High accuracy and repeatability**
- **Q.C. manufacturing tests and certification**
- **Burn-off port as standard**
- **Rapid response**
- **Interchangeable with all carbon sensors**
- **'Fast connect' DIN plug for electrical headbox connections**
- **2 standard lengths – 600mm and 900mm**
- **ISO9001 Accredited Management System**

Specification

Standard Probe maximum insertion lengths:	600mm = 550mm; 900mm = 850mm Maximum insertion length = the distance from the probe tip to the screwed gland.
Output:	1.00 to 1.20 V dc over operating range.
Temperature range:	760°C to 1100°C
Response time:	Less than 1.0 second
Accuracy:	± 0.05 weight % carbon in normal operating range
Range of operation:	Oxygen down to 10^{-30} atmospheres
Thermocouple:	Types K, R, S, N and No T/C
Maximum head temperature:	150°C
Probe sheath:	Special alloy – resistant to corrosion and oxidisation up to 1100°C
Diameter of sheath:	25.4mm O.D. nominal
Aperture required:	35mm minimum
Fitting detail:	Screwed fitting 1" NPT Male Adjustable Gland
Furnace insertion:	Minimum 75mm, aim 75mm to 100mm
Reference Air Flow:	200ml to 700ml per minute air (20.9% O2)

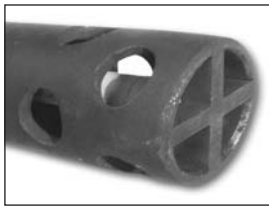


Theory of Operation

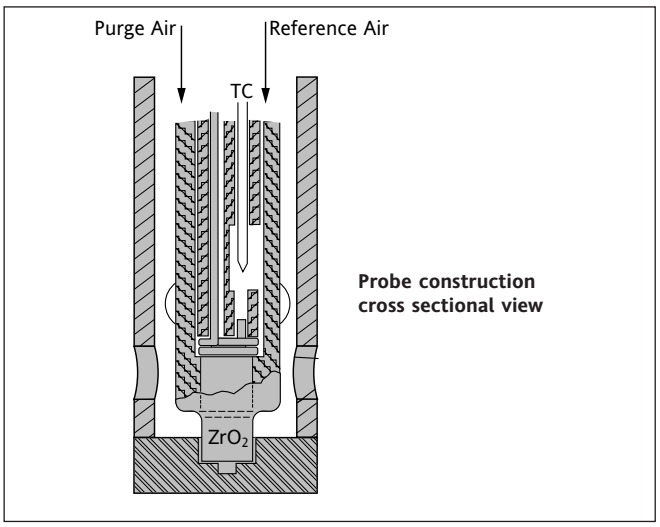
The ECProbe is a consumable item, similar to a thermocouple, which is mounted with its tip in contact with the furnace atmosphere. It is used in carbonaceous atmospheres to measure extremely small amounts of oxygen (1 x 10^{-20}) that is in chemical equilibrium with the CO/CO2 present in the atmosphere.

The probe is, in principle, a high temperature galvanic oxygen concentration cell. It is constructed of a stabilised zirconium oxide 'plug', welded into the end of an alumina tube using a patented eutectic welding process - the CSIRO sensor. The zirconia 'plug' is partially dosed with a non-electrolyte to achieve a coefficient of thermal expansion of this composite electrolyte material that matches that of the material of the supporting sensor body, alumina. Internal and external electrodes are attached to each end of the zirconia plug. The zirconia acts as a solid electrolyte which conducts electricity by O_2 ions above 600°C. The sensor is enclosed in a steel alloy protection tube to prevent thermal and mechanical shock, this tube also acts as the outer electrode.

The probe produces an output voltage which, in conjunction with the process temperature and atmosphere, can be interpreted in terms of the atmosphere carbon potential of the furnace. An inlet port for the supply of reference air to the inner electrode is located in the head of the probe, along with the electrical connections to the inner and outer electrodes. The probe is generally fitted with a thermocouple to give the process temperature in the probe tip region. The ECProbe is also fitted with a 'burn-off' port to allow the burn-off of carbon/soot deposits on the sensor tip from time to time.



Well ventilated and open tip design reduces sooting. The Alloy used for the probe sheath reduces the catalytic effect on free methane giving a more representative atmosphere reading.



Probe construction cross sectional view

The mV output of the oxygen probe is given by the ***Nernst*** Equation:-

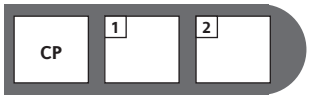
$$E = KT \times \ln \frac{pO_1}{pO_2}$$

where:

E = Probe output in volts
K = constant derived from the universal gas constant (R) and Faraday's constant (F), K = 0.0215
T = Temperature in ° Kelvin
pO1 = Partial pressure of oxygen in the reference gas (air = 20.9%)
pO2 = Partial pressure of the oxygen in the furnace atmosphere
ln = Natural logarithm

In gas carburising applications a voltage in the range 1000–1250mV is generated.

Order Code



Model	
CP	In-situ carbon probe

1 Length (mm)	
600	600 mm
900	900 mm

2 T-Couple Type	
0	No T/C
K	'K' Type T/C
N	'N' Type T/C
S	'S' Type T/C
R	'R' Type T/C

Example ordering code

CP600 - K

600mm length fitted with a 'K' type thermocouple

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