

## FOX™

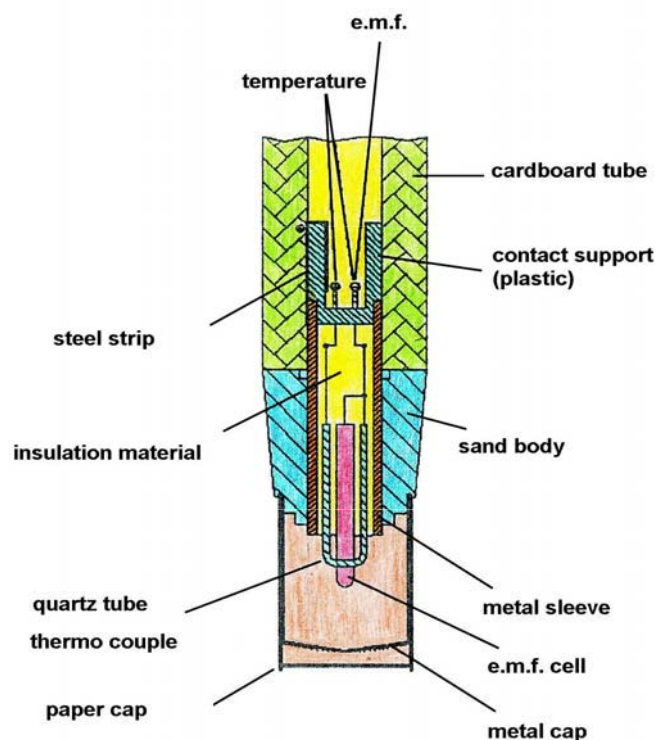
### Ferrotron Oxxygen activity measurement probe

The FOX™ probe was developed to determine the oxygen activity of molten metals. By means of this value and the condition of equilibrium, other important metallurgical parameters can be calculated such as Carbon content, Aluminum content, or Aluminum addition.

The FOX™ probe is in continuous development.

#### Design

The measurement head consists of a body of resin-bound sand with a metal sleeve inside. The metal sleeve consists of the EMF measurement cell and the thermocouple encased in refractory cement which serves as insulation.



The EMF measurement cell of the FOX™ probe consists of a magnesium oxide (MgO) stabilized zirconium oxide (ZrO<sub>2</sub>) tube closed on one side. A mixture of chromium and chromium oxide (Cr/Cr<sub>2</sub>O<sub>3</sub>) powder serves as the reference material. The internal reference electrode is formed by a molybdenum wire. The external reference is a bath contact formed by the metal sleeve of the measurement head.

The advantage of this reference mixture over other possible types lies in the oxygen's partial pressure range which is especially favorable for molten steel. There are different types of probes for the entire metallurgically-relevant range between approximately 1 ppm and 2,000 ppm for dissolved oxygen. A different reference mixture is used for copper and nickel melts.

FOX™ probes have Pt10Rh-Pt thermocouples Type: S as standard equipment for temperature measurements up to 1720°C. The thermocouple is built into a U-shaped quartz tube. For temperature ranges beyond 1720°C, FOX™ probes with Type: R thermocouple or Type: B thermocouple are manufactured.

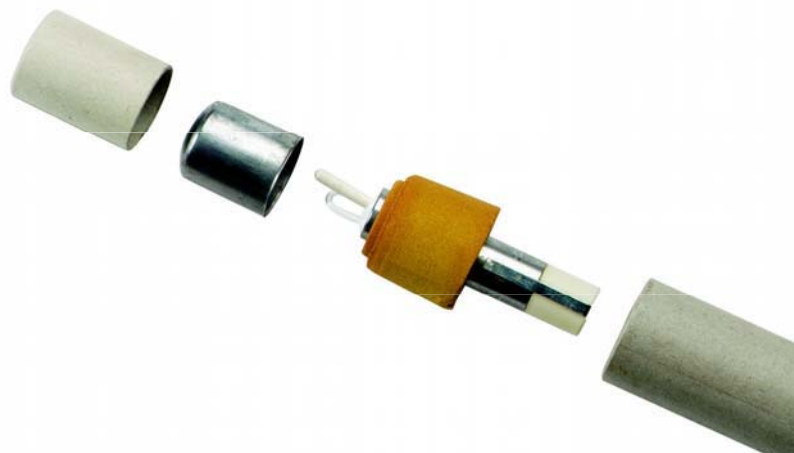
In the plastic contact carrier of the measurement head, the negative pole of the EMF measurement cell (reference side) is combined with the negative side of the thermocouple. This ensures that the device is compatible with the 3 pole coaxial connection of standard lances and all conventional measuring instruments.

The measurement head equipped with slag protection (steel cap and paper cap) is glued into a cardboard tube. The cardboard tube is available in various lengths in accordance with customer specifications.

### Calculation formula of the free reactive oxygen

$$a[\text{O}] = 10^4 * e^{-\frac{\Delta G^0}{R * T}} * \left[ \left( \frac{1}{p_e^4} + \frac{1}{p_{\text{ref}}^4} \right) * e^{-\frac{(c_9 * \text{EMF} + (c_6 + c_7 * T)) * F}{R * T}} - \frac{1}{p_e^4} \right]^2 + c_8$$

### Features of the FOX™ probe



- Tube cell with high temperature resistance and quick response time.
- Cr/Cr<sub>2</sub>O<sub>3</sub>- Reference mixture and partial pressure for entire relevant oxygen range inside the steel bath.
- Alternative reference mixtures for varied measurement applications in accordance with customer specifications are available.
- Using the “standard lance” coaxial contact means that most probes which “exclusively” measure temperature can also be used.
- The supplier of the FOX™ probe is also the supplier of the oxygen activity measurement instrument OxyNet™ metallurgical analysis computer. The entire measurement system can be purchased from a single supplier.

### Technical data

<b>EMF cell:</b>		ZrO <sub>2</sub> (MgO stabilized), tube crucible, Cr/Cr <sub>2</sub> O <sub>3</sub> -reference material. Internal conductor: Mo wire 0,3mm ∅ External conductor: Metal sleeve Negative pole compensation wire DIN 43713, 1,38mm ∅; Positive pole – steel strip
<b>Thermocouple:</b>		Pt10Rh-Pt (type S), Pt13Rh-Pt (type R) or Pt30Rh-Pt 6Rh (type B), 0,07mm ∅ according to DIN IEC 584-1 depending on the temperature range Negative pole compensation wire DIN 43713, 1,38mm ∅; Positive pole - DIN 43713, 1,5mm
<b>Insulation material:</b>		Special refractory cement
<b>Contact carrier:</b>		Elastic plastic contact fitting to 3-pole “standard lance” coaxial contact, effective contact length 10mm
<b>∅ Measurement range:</b>	EMF:	-300mV up to +200mV in molten steel baths
	Thermocouple:	1200°C up to 1720°C (Pt 10 Rh-Pt), type S 1200°C up to 1800°C (Pt 30 Rh-Pt 6 Rh), type B
<b>Response time:</b>	EMF:	0,5 up to 2s (depending on the level of oxygen activity , the melt's characteristics and the temperature)
	Temperature:	2 up to 4s (with steel cap only above 1520°C)
<b>Reproducibility:</b>	EMF:	between ± 1mV and ± 5mV (depending on the level of oxygen activity, the quality of the melt and when handled with care)
	Temperature:	± 1°C with T-certificate available on request: Tolerance improved to class 1 DIN IEC 65B (CO) 23 (or DIN IEC 584-2)
<b>Dimensions:</b>		Standard probe Nominal length: 1200mm or 1700mm Diameter: 39mm external, 17,5mm internal Other dimensions available on request.

Information contained herein is believed to be accurate and reliable. However, no responsibility is assumed by Minteq/Ferrotron for its use. Technical data are subjected to change without notice.

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