MESSER
Gases for Life

Messer's Oxygen Sensor.

How do you control your oxygen processes level?

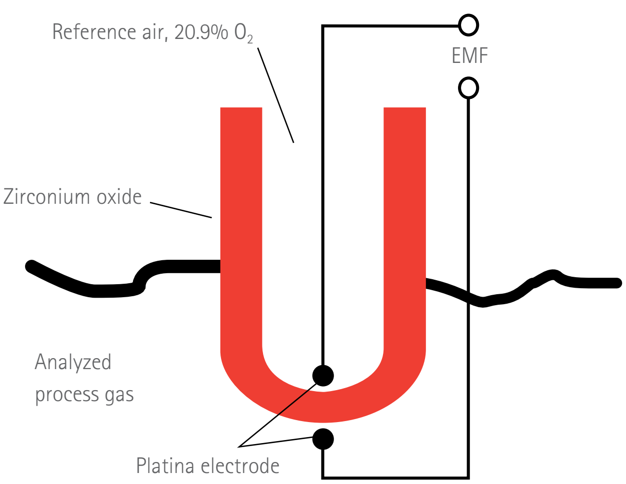
Stringent quality requirements demand quality equipment.

Determining the oxygen content in different types of atmosphere is a demanding task in many cases which is why instruments that measure oxygen concentration must comply with stringent quality requirements. Messer's oxygen sensor is based on well-established technology (zirconium oxide cell) with a design that allows measurements in a wide range of atmospheres. Precise measurements in percent down to fractions of ppm are standard. Messer's know-how regarding gas management etc. ensures that important components in the instrument such as the pump, flow meter, and flow path are of the highest quality.

Description of the instrument

Messer's oxygen sensor is available in different designs. The POA model is a port-able oxygen analyzer and the ISM model is adapted for wall mounting. The instrument is based on lambda sensor technology. Lambda sensor technology is the state of the art in fuel control within the automotive industry and thereby high quality; long lasting sensors are produced at a reasonable cost.

Measurement of oxygen content – Schematic description of oxygen sensor



To measure the oxygen content, Nernst's equation (1) is used where $PO_2(X)$ is the oxygen pressure which is to be measured. $PO_2(REF)$ is the reference pressure which in this case is 0.209 as the reference gas is represented by the ambient air. T is the absolute temperature in Kelvin and C1 and C2 are constants.

By measuring the voltage EMF using the sensor, the applied oxygen content $PO_2(X)$ can be calculated.

$$EMF\ (mV) = C_1 {*} T \text{ Log } \frac{PO_2(X)}{PO_2(REF)} + C_2$$

Messer's oxygen sensor models are characterized by various features including the following

- Atmosphere analysis with extractive sampling (gas is drawn from the sampling point to the measuring sensor)
- Sensors mounted in the specially designed flow block ensure that the measurement result is independent of the gas flow within a broad flow interval
- The sensors are quality assured and tested for tightness with a long- term test before shipment
- Selected electronics ensure a constant sensor temperature which improves repeatability of the measurement result
- The measurement principle and quality of the sensors mean that it is suitable for continuous measurement where long life- time is strived for
- In the event of a gas leakage, the construction of enclosure secures a good natural convection preventing the risk of buildup of hazardous gas levels inside the oxygen sensor
- Acid-resistant stainless steel enclosure
- Gas-adapted components and connections

Examples of areas of application

With its wide scope of management, 100% O_2 – 10-25 O_2, the oxygen sensor is suitable for a large number of applications. See below for some examples of applications.

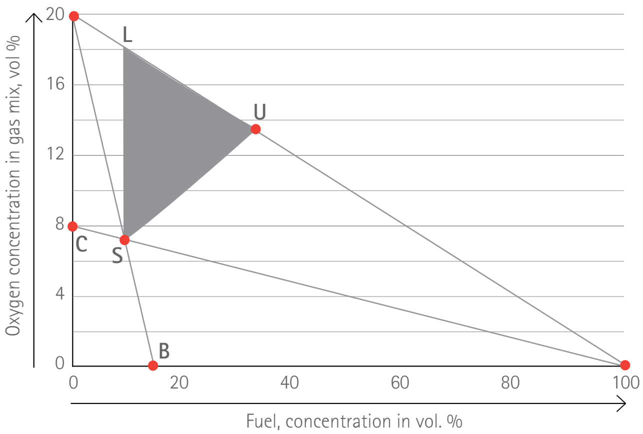
- Furnace atmosphere check when heat treating solid metal components and powder material. Examples of processes are tempering, annealing, hardening and sintering of powder components
- Furnace atmosphere check when switching between oxidizing (air) to active gas via inert gas (see Fig. 1)
- Control of atmospheres (inerting) in powder processes where there is the risk of dust or gas explosions
- Control of areas where there is a risk of asphyxiation due to the low oxygen content
- Measuring the oxygen content in medical areas and in the food industry
- Determining the oxygen content within different types of R&D areas

Application examples:
Inerting and control of flammable atmospheres

In terms of safety, flammable gases can be characterized with the help of a so-called combustion triangle which illustrates within which limits a gas mix is flammable and therefore a potential hazard. Figure 1 is a schematic representation of how such a diagram looks for a mixture of air and a combustible gas. The size of the triangle for a flammable gas mix varies considerably and, in addition to the gas in question, depends on factors such as temperature and pressure.

Figure 1. Basic structure of the combustion triangle

L Lower combustion limit in air
U Upper combustion limit
S Min O_2 conc. for combustion
C Start-up
B Point of evacuation of flammable gas



The diagram shows that if, for example, a furnace space is inerted with N_2(g), inerting must be made down to the oxygen level for point C before the combustible gas in question can be added. At this point, the combustible gas can be added in any concentration along the path C-S 100%, without risking uncontrolled combustion. When evacuating the furnace chamber of flammable atmospehere, the chamber must first be flushed from the current fuel mix to point B. Then it is safe to open the furnace chamber toward air and the gas mix will change along the line B-S-21% O_2. Messer's oxygen sensor is an excellent tool for ensuring that the oxygen concentration is at a safe level before any flammable gas is added to the furnace space.

For wall mounting: Messer's oxygen sensor, ISM model, Portable oxygen sensor, POA model

Technical specifications

Dimensions POA	Height 190 mm, width 200 mm, length 330 mm (7.48"H x 7.87"W x 12.99"L)
Dimensions ISM	Height 330 mm, width 240 mm, depth 190 mm (12.99"H x 9.45"W x 7.48"D)
Gas connections in/out	6 mm Swagelock
Weight	6.0 kg
Cabinet	Stainless steel enclosure, IP21
Supply voltage	230 V (+/-10%), 50 – 60 Hz, 100 VA, connected to earth
Temperature range	Sensor temperature approx. 1292ºF Incoming gas temperature 50 - 302ºF. Ambient temperature 41-122ºF
Type of oxygen sensor	Zirconia electrolyte sensor
Measurement range	100% O_2 – 10^{-25} O_2
Time for heating of sensor	Approx. 30 minutes
Flow meter	Rotameter with sphere 0.4 – 2.5 scfh
Reference gas	Air with calculated content of 20.9% O_2
Absolute measurement area	< +/- 1% of read value
Lifetime of sensor	Normally > 20,000 measurement hours
Response times for the sensor	5 seconds for T90 with gradual decrease from 20.9% O_2 to 1,000 ppm O_2. 10 seconds for T90 from 1,000 to 10 ppm
Display	4-digit 14-segmented LED display which shows the oxygen concentration in the ranges 0-25%, 0-10,000 ppm, 0-1,000 ppm, 0-100 ppm and 0-1,500 mV
Signals/alarm from the oxygen sensor	Analogue signal 0/4 – 20 mA, 4 x relay outputs programmable via the display. EMF(mV) which may be used to calculate the oxygen content from Nernst's equation
Ventilation of enclosure	The buildup of hazardous levels of flammable gas at inner leakage, is prevented by the natural convection of the closure
Gas atmosphere	The product is approved for the measurement of atmospheres with up to 50% hydrogen content. No interference with N_2, Ar, He, CO_2, H_2O, SO_2 and HCl
Design principles	Designed in accordance with the directives for EMC, LVD and machine safety

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