

ASCOMB System
Zirconium Oxide Probe for oxygen
measurement in flue gas
Series ZO2
& Heater Power Supply mod.AZO-AL



Intallation and User Manual
M.I.U. ZO2 – AL / 6/10.01/E



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1. General description and operating principle

The series ZO2 Zirconium Oxide probe is used for the in-situ continuous measurement of the oxygen percentage in "wet" flue gases. The flue gases are defined "wet" because the combustion chamber also contains steam produced by the combustion of hydrogen, by the water of the fuel and the humidity contained in the combustion air.

Other methods are based on the "dry" gas analysis, in which steam is previously condensed and the water is removed.

Ascomb system is based on the analysis of wet gases. The measuring sensor is a zirconium oxide (ZrO₂) type. The flue gas reaches the sensor, inside the probe, without the need of external devices.

A free air reference circuit is not required because ambient air, present in the probe head, reaches the sensor and provides the necessary reference. The sensor generates a mV signal inversely proportional to the O₂ content. This signal can be directly applied to the Monitor and/or Controller of the Ascomb system. One side of the zirconia sensor is exposed to the gas to be measured and the other side to the reference gas (ambient air).

When two different oxygen concentrations exist across the cell, oxygen passes through the zirconium oxide cell wall in the form of ions. This generates an inverse logarithmic voltage signal, proportional to oxygen content in the process gas, according to the Nernst equation:

$$E = (RT/4F) * \ln (ppO_{2ref} / ppO_{2gas}) + C$$

Where :

E = Electro motive force in mVolts

ppO_{2ref} = Oxygen partial pressure of reference gas (air)

ppO_{2gas} = Oxygen partial pressure of measuring gas

R = Gas constant

F = Faraday constant

C = offset constant

Since the sensor signal is also influenced by the temperature, the probe is provided with a built-in heater. It is connected to the external power supply, model AZO-AL/..., and maintains the sensor at a constant temperature of 600°C (1112°F)

2. Installation and precautions

The probe is suitable for direct insertion into the stacks of boilers, furnaces, etc. burning natural gas, LPG, propane, light oil and other low sulfur fuels. Attention should be paid with liquid and solid fuels.

Typical contaminants that can damage the sensor are: lead, vanadium and other heavy metals, fluorine and chlorine acids, sulphur and especially silicon compounds.

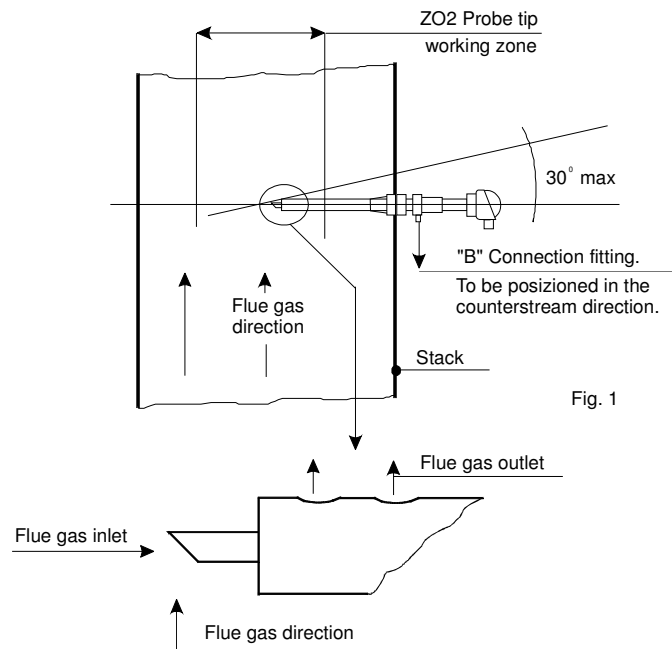
The maximum temperature of the flue gas must not exceed 550°C (1022°F).

1. The probe shall be installed at the base of the stack or in the channel between the combustion chamber and the stack at the point where the combustion gas flow is most likely to be homogeneous and has the least turbulence
2. The probe shall be installed in such a way to form a 90° angle with respect to the gas flow. The "B" connection fitting (see figures 1 and 2) shall be positioned in the flue gases in the counter stream direction, to assure correct positioning of the probe gas inlet and outlet.
3. In order to obtain the optimum probe insertion depth, proceed as follows:
 - Make the electrical connections as shown in fig. 3
 - Carry out the start-up procedure described under paragraph 4 of this manual
 - Read the oxygen percentage on the receiving instrument
 - Slowly insert the probe to find the optimum zone in which the measurement becomes stable.
 - Lock the probe in position by tightening the fixing nipples.

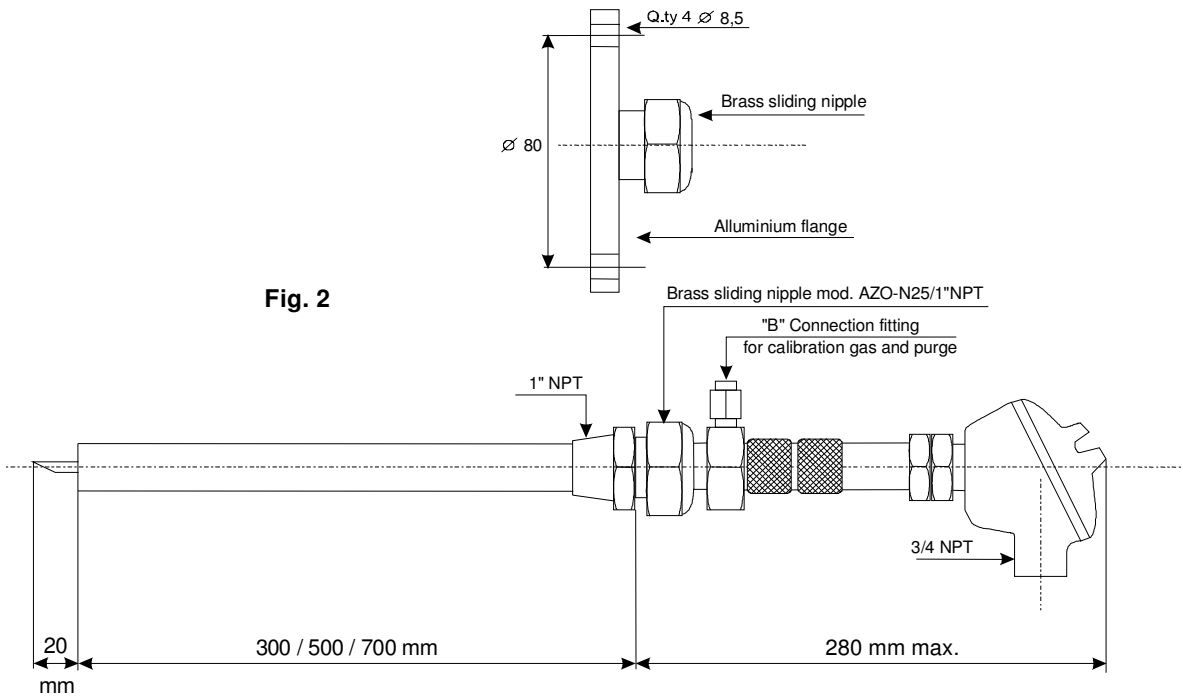
The installation procedure is completed.



In order to avoid condensation on the sensor, it is necessary to leave the probe heater switched on during the shut-down periods.



2.1 Dimensions and fixing accessories



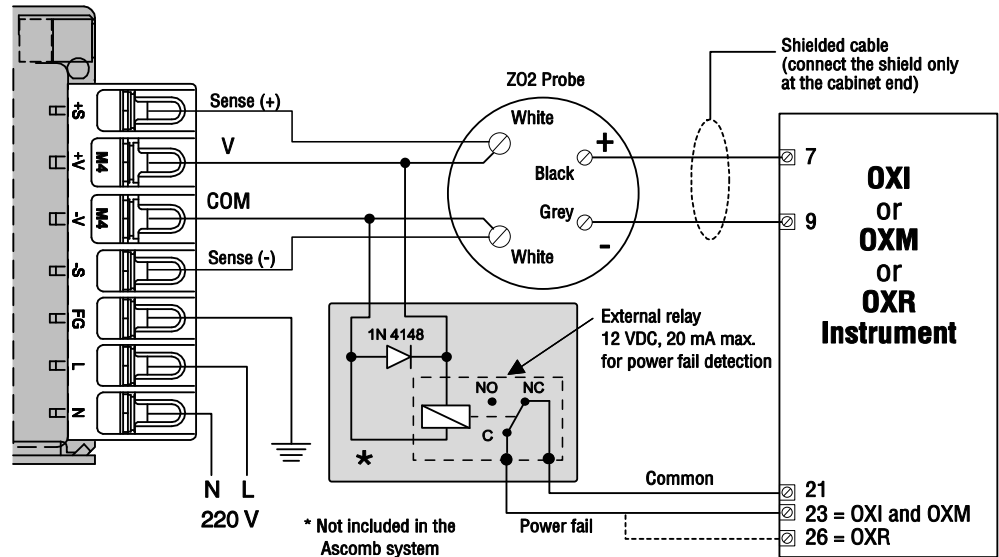
Use the sliding nipple mod. AZO - N25/1" NPT or the sliding flange mod. AZO - F25 (supplied separately) to lock the probe in position.

3. Electrical connections

For connections between the probe and the power supply and between the probe and the receiver instrument it is advisable to utilise shielded, twisted pair cables with a 1.5mm² cross section. The maximum distance between the probe and power supply and/or OX instrument is about 50 meters. For the electrical connections see figure 3.



*The negative terminal for the mV output signal from the ZO₂ probe is directly connected to the metal body which becomes the negative pole of the probe, the negative input of the receiver instrument **is connected directly to earth***



4. Start - up



Every probe is factory calibrated. The two calibration coefficients CC1 and CC2, are stamped on the name plate fixed in the head of the probe.

When a complete Ascomb System is delivered, with Monitor and/or Controller instrument, it is necessary to enter, the two calibration coefficients (CC1 and CC2) of the probe before start-up (see programming procedure in the OXM or OXR instruction manual). The same operation described above shall be performed when the probe is replaced by a new one.

Make sure that the electrical connections between the probe and the power supply unit have been made correctly (see fig. 3 and 4);

- Wait 10 minutes to allow the probe heater to reach the operating temperature and stabilize;
- The probe is ready to operate.

5. Calibration

Under normal operating conditions, it is suggested to recalibrate the ASCOMB System every six months.

The calibration operation shall be carried out with the following sequence:

- 1st point of calibration curve : fresh air; (instrument air at 20,9 % O₂)
- 2nd point of calibration curve : span gas. (gas sample at about 1% vol. O₂)

The calibration shall be carried out in accordance with the calibration procedure of the receiver instrument (see Ascomb Monitor or Ascomb Controller instruction manuals).

The probe is provided with a 1/8" NPT connection fitting (fig.2), which can be used to calibrate the system with fresh air and with a sample gas ("B" connection is also used for cleaning, see "Maintenance" paragraph).

To perform the calibration proceed as follows:

- Connect the air, with 20.9 %O₂ content, to the "B" (See fig.2) connection fitting.
- Carry out the calibration procedure in accordance with the Monitor and/or Controller instruction manual (calibration with air).
- Connect the sample gas bottle to the "B" (See fig.2) connection fitting.



The sample gas bottle used for calibration shall contain the following gas:

from 0.3 to 3.0 %O₂ + N₂ for the balance

- Carry out the calibration procedure in accordance with the Monitor and/or Controller instruction manual (calibration with sample gas).
- Remove the sample gas can and close the "B" (See fig.2) connection fitting with the plug.
- The calibration procedure is completed.

The calibration requires the use of a sample gas can, pressure reducer/controller, flowmeter, connecting pipes, connection fittings and all necessary accessories, in order to guarantee at the probe "B" connection the following values:

correct flow rate of fresh air and sample gas: 20 lt/h.

The above listed equipment is not supplied with the ASCOMB System.

6. Maintenance

The probe does not normally require any maintenance.

Periodic cleaning is suggested to prevent unburnt combustion deposits which can affect the circulation of the flue gas inside the probe and even obstruct the inlet and outlet holes.

To clean the probe proceed as follows:

- Connect a dry compressed air pipe to the “B” connection fitting (See fig. 2) (use a filter to prevent the entry of oil, dust or impurities) with a relative pressure of **2-3 atm** for few seconds (sensor and pipe cleaning).
- Complete the cleaning procedure by removing the compressed air pipe and by closing the “B” connection fitting with the plug.

During the cleaning phase it is necessary to exclude monitoring or controlling instruments connected to the probe, the logic “HOLD” input of the instruments can be used for this purpose (see Monitor and/or Controller instruction manual).



When the operating conditions are within the recommended limits, two probe recalibrations per year are suggested by Ascon, see paragraph 4 of this manual.

7. TECHNICAL DATA

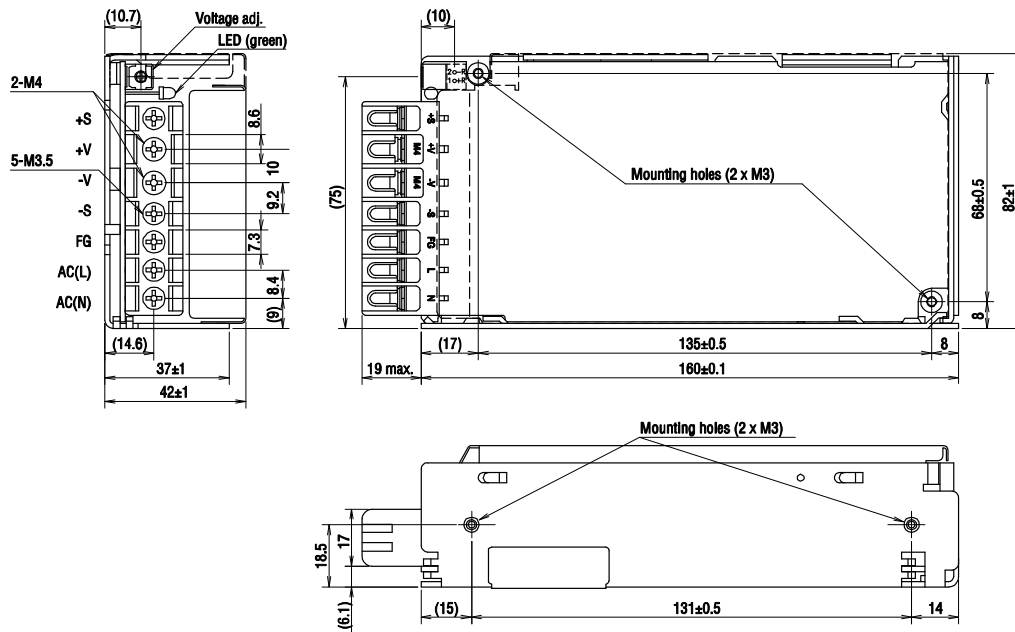
7.1 Technical data ZO₂ PROBE

- **Measurement type:** Direct and continuous measurement of the oxygen content in wet **flue gas**
- **Sensor:** Heated zirconium oxide ZrO₂
- **Heater:** 600°C (1112°F) Self controlling element, 12 VDC, 1.3 A power supply from the AZO -Al/. series power supply unit
- **O₂ measurement range:** 0.3... 20.9 % O₂
- **Accuracy:** 3% of measured value between 0.5 and 10 %O₂
- **Response time:** Less than 5 seconds
- **Gas temperature:** Max. 600°C (1112°F)
- **Heating up time:** 10 minutes
- **Ambient temperature:** -20... 70 °C
- **Calibration intervals:** 6 months under normal operating conditions
- **Probe material:** Stainless Steel AISI 316
- **Electrical connections:** 2+2 terminals for 1.5 mm² (AWG 14) wires
- **Mounting position:** 90° angle with respect to the gas flow
- **Insertion lengths:** 300, 500, 700 mm standard. Other lengths on request
- **Connection to process:** With 1” NPT-M sliding nipple mod. AZO - N25/1” NPT or sliding flange Mod. AZO - F25 (optional)
- **Head protection:** IP 65
- **Weight:** 1100/1500 g max.

7.2 Technical data POWER SUPPLY UNIT AZO/AL

Input range:	88...265 VAC, 50/60 Hz
Input current at max. load:	4.5 A
Output voltage:	12 VDC stabilized,
Output power:	156 W max.
Output Power connection (note):	Screw terminals
Remote sense connection (note):	Screw terminals
Ambient temperature:	0...50°C
Dimensions:	37 x 82 x 160 mm
Mounting:	with provided mounting bracket
Protection fuse:	5 A
Enclosure rating:	Internal use only

Note: The section of the power and sense conductors must be at least 1.5 mm².



Warranty

The equipment is guaranteed free from manufacturing defects for 1 year after installation, for a maximum of 18 month after delivery.
Faults caused by use other than that described in the operating instructions are excluded from the guarantee.

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