

OXYGEN PROBE

INSTALLATION AND OPERATION

MANUAL

Version Number 004



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INTRODUCTION

General

Congratulations, you have purchased an Oxygen Probe developed and manufactured by Furnace Control Corp a member of United Process Controls.

This high temperature oxygen probe is specifically designed for atmospheres containing free oxygen, such as combustion, incinerator, or kiln applications.

Principle of Operations

The relationship between oxygen probe voltage output and temperature and oxygen content of the measured atmosphere is described below.

A closed end stabilized zirconia tube is used for the solid oxide electrolyte. The reference electrode which is located at the bottom of the interior of the zirconia tube is designed to be in contact with a continuous flow of air. The P_{O_2} at the air, i.e. 0.209atm. The sensor shown in Fig.1 is located directly in the heated atmosphere to be measured so that the electrode on the outside of the stabilized zirconia tube is exposed to this gas atmosphere. The oxygen partial pressure in the atmosphere, P_{O_2} , is determined from the voltage output of the sensor, E , and the furnace temperature, T , by the well known Nernst expression:

$$P_{O_2} = 0.209 \times 10^{-E/0.0496T} \quad (\text{Eq.1})$$

where E is the probe output in millivolts and T is the probe temperature in °K.

The % oxygen of the atmosphere is given by Eq.2:

$$\% \text{Oxygen} = 20.9 \times 10^{-E/0.0496T} \quad (\text{Eq.2})$$

where E is the probe output in millivolts and T is the probe temperature in °K

ACCURACY

The voltage output should be measured with a precision of about ± 1 mv. For example, if the oxygen content of the atmosphere is 1% oxygen and the temperature is 2400°F (1316°C), a variation of ± 1 mv corresponds to variation of $\pm 0.03\%$ oxygen.

INSTALLATION

Probe Location

The general guideline is that the oxygen probe should be exposed to the gas atmosphere that is representative of the atmosphere to be controlled or monitored (in-situ vs. sampled exposure). The probe location should also be in a temperature range where the probe is designed to operate, 1400°F (760°C) - 2500°F (1372°C). It should be noted that the probe head should be in a location where the probe head temperature will not exceed 200°F (93°C).

Note: Determine the proper probe length at the location selected to make sure that it will not interfere with muffle components, radiant tubes, fan blades, gas ports, or any other furnace components. The probe length is adjustable and the probe need not be inserted to the maximum length.

WARNING!

Before proceeding, remove all combustible atmosphere from furnace, open all doors and cool furnace to room temperature

FURNACE PREPARATION

After the location of the probe is determined to be acceptable, as described above, a port with a female 1-inch NPT thread and 1 1/2-inch I.D. clearance is required. The use of a probe mounting flange Part No. 1.2F-10, simplifies the task to prepare a port in the furnace.

The “probe mounting flange” has a precision 1-inch NPT thread machined into it and has an alloy pipe extension to line and support the furnace refractory. Use of this part is strongly recommended to minimize problems and to simplify the installation of the oxygen probe.

1. Saw or Torch-cut a 2 1/2” diameter hole in the steel shell of the furnace at the probe location determined above.
2. Using an insulation boring tool, bore a 2” diameter hole through the thermal insulation, concentric with the 2 1/2” hole in the steel sidewall and perpendicular to the sidewall. Remove boring tool and core of insulation.
3. Insert “probe mounting flange” into hole in furnace sidewall. Flange should fit flush against sidewall. If not, take necessary steps to remove interference material.
4. Using the “probe mounting flange” as a template, mark location of the four mounting holes on the furnace wall and remove the furnace flange.
5. Drill and tap the four holes with 3/8” NC thread.
6. Insert the “probe mounting flange” in the furnace sidewall hole with a gasket between the flange and the furnace sidewall.
7. Secure the flange to the furnace sidewall with four (4) 3/8” NC hex head bolts 3/8” long. A 1” pipe plug should be used to close hole in probe mounting flange allowing normal furnace operation until the oxygen probe is ready for installation.

Note: In new furnaces or newly rebricked furnaces it is important that the refractory be fully dried and cured before the probe is installed. Binders and some mortar components released during curing can affect probe accuracy and shorten the probe life. It is strongly recommended to operate the furnace for at least 8 hours at 1700°F or higher to flush out potentially detrimental refractory components

WARNING!

Before proceeding, remove all combustible atmosphere from furnace, open all doors and cool furnace to room temperature

PROBE INSTALLATION

Installation of the oxygen probe should only be attempted after a proper furnace port is ready and all interconnecting wire, reference air tubing, and air supply are in place.

READ THESE INSTRUCTIONS COMPLETELY BEFORE ATTEMPTING THE INSTALLATION.

Note: If you plan to install the oxygen probe in a furnace port previously used for another probe or some other function, make certain that the threads are 1" pipe thread (NPT), the I.D. is at least 1 ½" and that the hole is straight and open on the end.

Use extreme care when handling and installing the oxygen probe. It is susceptible to thermal and mechanical shock and may be damaged if mishandled.

1. Carefully remove the oxygen probe from the shipping box and inspect for damage by looking for broken ceramic pieces. It is not necessary to open the probe cover for damage inspection. If damage is observed or is suspected, notify the carrier who delivered the probe.
2. Remove 1" NPT plug from center of furnace flange or port, which has been installed on furnace sidewall according to previous instructions.
3. Check the port I.D. for any obstruction and remove collected debris using compressed air or brush.
4. Remove compression fitting body from the oxygen probe. Leave the nut and seal rings or O-rings on the probe sheath. Put Teflon plumbers tape on pipe threaded end of compression fitting. Thread compression fitting into furnace flange. Tighten with wrench but do not exceed 20 ft.-lb.

If the furnace is 300°F or cooler, slide probe into compression fitting to the desired depth. Make sure seal rings or O-ring is between compression fitting body and nut. Hand tighten nut on probe sheath. Do not rotate probe while tightening nut.

Note: It is preferable that the furnace be at 300°F or cooler for probe insertion; however, if the temperature is above 300°F, the following instructions must be followed in the sequence given or thermal shock may damage the probe.

5. Measure 6 inches from the end of the probe sheath and mark with a felt tip pen. Mark the remainder of the oxygen probe in 1-inch graduations.

6. Carefully insert probe into compression fitting to the first mark on the probe sheath (6-inch mark). Make sure seal rings or O-ring is between compression fitting body and nut. Wait 5 minutes while the probe warms up.
7. Insert probe at the rate of about 1-inch per minute.
8. Repeat step 7 above until probe is installed to proper length. Hand tighten compression fitting nut on the probe sheath.
9. Connections for the probe signal and also integral thermocouple are made through the black electrical connector located at the underside of the probe cover. If you are using a probe cable supplied by the connector installed on the end of the cable and T.C. extension wire, will mate with the connector on the probe cover. Your new probe was shipped with a 10ft cable assembly.

Probe Wiring Information

- The Gray colored shielded cable contains the probe mV output wires:
 - Black insulated wire is positive (+)
 - White/clear insulated wire is negative (-)

 - Thermocouple extension wires are contained in:
 - Green colored shielded cable for 'R' & 'S' thermocouples
 - Red insulated wire is negative (-)
 - Black insulated wire is positive (+)
 - Red colored shielded cable for 'B' thermocouples
 - Red insulated wire is negative (-)
 - Black insulated wire is positive (+)
10. Reference air connection is made through the brass ¼-inch tube fitting adjacent to the electrical connector. Either soft plastic or copper tubing can be used. Remove nut and ferrules from brass body or air fitting on the underside of the probe cover. Place nut and ferrules on reference air tube and connect to air fitting. Hand tighten nut on air fitting, and then turn ¾" with a wrench to set ferrules on tubing. Once the ferrules are set on the tubing, hand tightening of the nut is adequate.

CAUTION: DO NOT REMOVE AIR FITTING BODY OR VERIFICATION AIR FITTING BODY FROM PROBE HEAD, OTHERWISE PROBE WILL MALFUNCTION.

SPECIFICATIONS

A patented*, ceramic sheathed, high temperature oxygen probe, specifically designed for atmospheres containing free oxygen, such as combustion, incinerator or kiln applications.

Continuous probe operating temp.	1400-2500°F
Probe head temperature limit	200°F maximum
Sensitivity	± 0.1mv
Accuracy	± 1.0mv, for example @ 1% O ₂ , 2400°F 1mv=.03%O ₂
Stability	± 1mv over probe life
Response time	Less than 5 second
Impedance	Less than 4000 ohms
Calibration	None required
Probe construction	high purity alumina sheath; Stabilized Zirconia solid electrolyte; Pt-Rh alloy electrode; patented woven refractory sleeve
Assembly thermal shock	Some caution is advised, both Ceramic sheath and Zirconia tube are temperature sensitive
Life	About 2 years with normal use
Serviceability	No field service required, completely re-buildable at factory with substantial savings
Reference air required	.2-1.0 SCFH ambient air
Thermocouple	26ga. type S standard 26ga. type B or R optional
Connections: Probe & T.C.	AMP 4 pin CPC connector
Ref. Air	¼" O.D. tube fitting
Dimensions: Overall length	27"
Insertion length	Variable from 6" to 20"
Probe diameter	1.00"
Mounting thread	1" male NPT
Probe Weight	3.5 Lbs.
Shipping Weight	7 Lbs
*Foreign Patents Pending; US Patent No.4,814,061	

