

Operating Handbook

METROTEC

Systems for oxygen measurement

CLX

Carbon Sensor CLX-700S/900S

Type CLX

*** Version 2.0 ***

Declaration of Conformity

for
Carbon Sensor
CLX-700S/900S

This device has been designed for industrial purposes in accordance with:

EN 61000-6-4
EN 61000-6-2

It is compliant with the directives:
EMC Directive: 2014/30/EU
Low Voltage Directive: 2014/35/EU
RoHs: 2011/65/EU

This device complies with following standards:

EN 61010-1
EN 61000-6-4
EN 61000-6-2
EN 63000

Description of measures taken to assure compliance:
Quality management system DIN EN ISO 9001:2015, No. 12 100 27736 TMS

This declaration becomes invalid if changes are made without
our consent.



Kirchheim/Teck, 07/10/2019

Place, Date

Signature

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1 Safety instructions



Please read through this operating manual very carefully before installing and commissioning the unit.

Incorrect utilisation will invalidate the guarantee!



Correct functioning and the operating safety of the unit can only be guaranteed if the ambient conditions specified in the Specifications chapter are maintained.



Only qualified specialists are permitted to commission and operate the unit. The owner of the unit must ensure that the installation complies with the relevant laws and directives. These include, for example, the EU Directives covering safety in the workplace, national safety in the workplace regulations and the prevention of accidents regulations, etc.



You must ensure that the power supplies concur with the details listed on the nameplate. All of the covers needed to ensure that the unit cannot be touched when operating must always be fitted. You must consider the effects of the overall operation and take the necessary precautions if the unit will be linked up with other equipment and/or devices before you switch on.



Parts and surfaces will occasionally become and remain hot during the installation or de-installation. Suitable precautions must be taken in order to prevent injuries or damage to the unit from occurring.



If the unit shows signs of having been damaged and you are of the opinion that that safe operation is no longer possible then you must not run the unit. We recommend that periodical inspections are carried out at our factory or by our customer service department at least once a year.



Future disposal must always comply with the legal regulations.

2 Introduction

The oxygen monitor and its accessories were subjected to constant quality control and tests in the course of their construction.

All locally applicable regulations and codes of practice should be complied with in the course of their installation and use. In Germany these particularly include VDE and DVGW codes of practice.

The function and accuracy of the measurement system needs to be checked regularly at intervals depending on the application concerned. Such a check must be effected when the system is installed and put into operation for the first time.

3 Measurement principle

The Type CLX Oxygen Measurement Unit is designed to process signals from a stabilized zirconium oxide sensor. Zirconium oxide is a ceramic material, also characterized as a solid-state electrolyte, that has outstanding properties as an oxygen-ion conductor at high temperatures.

Within a certain temperature range, that depends on how the material is doped, such ionic conductors are able to fill the open spaces in their crystal grating with oxygen ions. The oxygen ions form on a conductive contact surface, generally of platinum, and thus the degree of oxygen activity is determined by the concentration of oxygen in the gas that is measured.

In principle, the sensor is in the form of a solid-state electrolyte that is contacted on both sides, on the one side by a reference gas such as air and on the other by the gas to be measured. The sensor is so formed mechanically that the two gases are kept apart so that there is no possibility of them mixing.

Depending on the application concerned, the sensor may be heated or unheated. Unheated sensors are chiefly used within furnaces while heated sensors are used where the gas to be measured has a temperature below 650 degrees Celsius, since the measurement principle necessitates the sensor being at a temperature of at least around 650 degrees.

Heated sensors are provided with electronic temperature regulators to keep them at a predetermined temperature. The electronically measured temperature of both heated and unheated sensors is an important factor in the calculation of the oxygen content (oxygen partial pressure).

Calculation is effected in accordance with the equation:

$$EMF = \frac{R \cdot T}{4 \cdot F} \cdot \ln\left(\frac{P_1}{P_2}\right)$$

whereby:

- R = 8.31J/mol K
- T = Temperature in Kelvin
- F = 96493 As/mol
- P₁ = Oxygen partial pressure on reference side at 0.20946 bar
- P₂ = Oxygen partial pressure on the measurement gas side
- EMF = Electromotive force in Volts

4 Construction

The sensors are targeted for direct installation into a hot reaction chamber. They consist of a head piece and an insert. The head piece is equipped with the connectors for the scavenging air supply and the reference air supply, as well as the electrical E.M.F. signals and the temperature measuring function. The insert, with its threaded hole, is equipped with external ceramics or metal protective tubes (electrodes).



CLX Sensors

Type	External electrode	Reference connection	Scavenging air connection
CLX...	Metal	Rapid-action coupler "R"	Rapid-action coupler "S"

Table: Constructional features of the different types

Standard lengths are 700 and 900 mm with an "S" type thermocouple

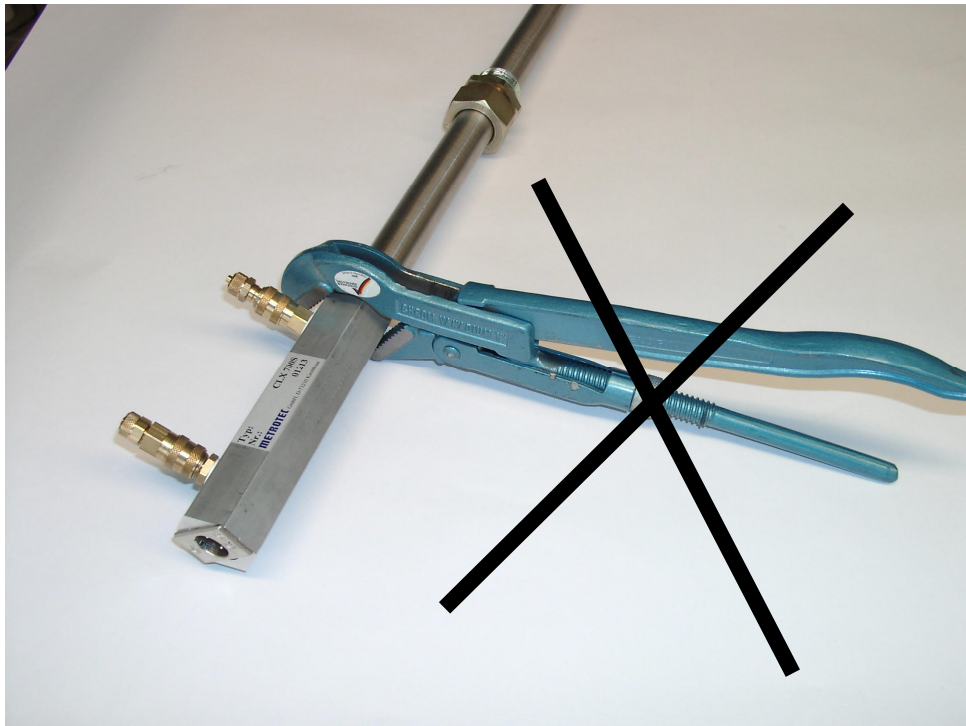
5 Installation

Installation may only be performed by specifically trained expert personnel!

During installation into the furnace, make sure that there is enough tolerance for the sensor inside the furnace duct. This is particularly important in conjunction with the thermal expansion of the plant.

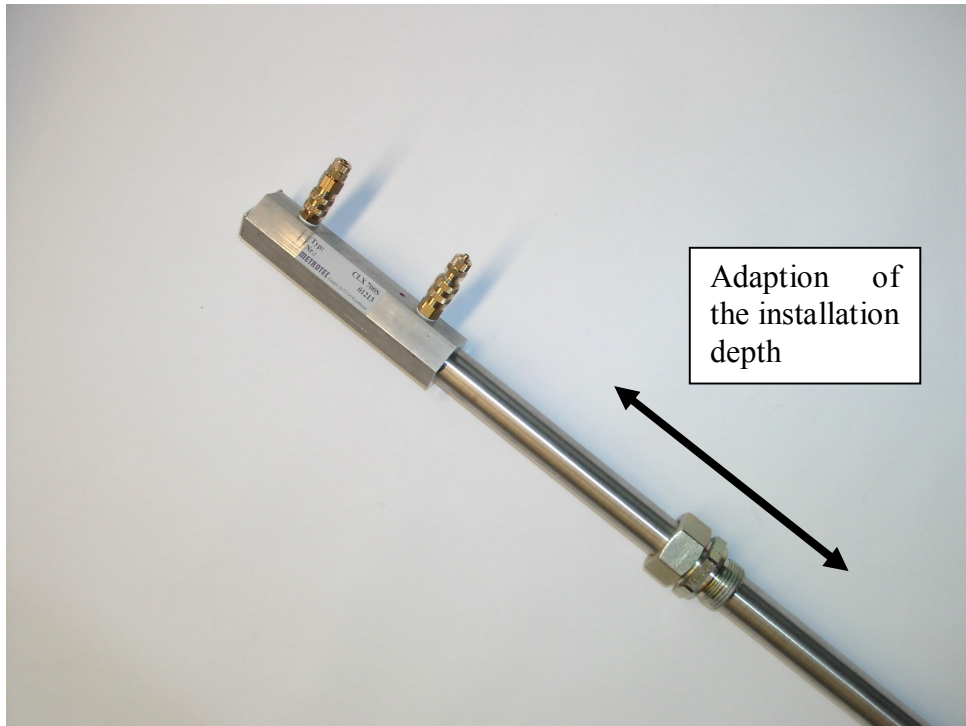
At first the sensor should be installed in a cold furnace, so that the installation position and the process itself can be closely monitored.

If installation is only possible in a hot furnace, the sensor will have to be pre-heated at approx. 30 – 50 °C. To this end, leave it inside the furnace for one hour, making sure it is exposed to the mentioned temperature. At furnace temperatures in excess of 800 °C, the next installation should be performed at a rate of approx. 5 cm per minute.



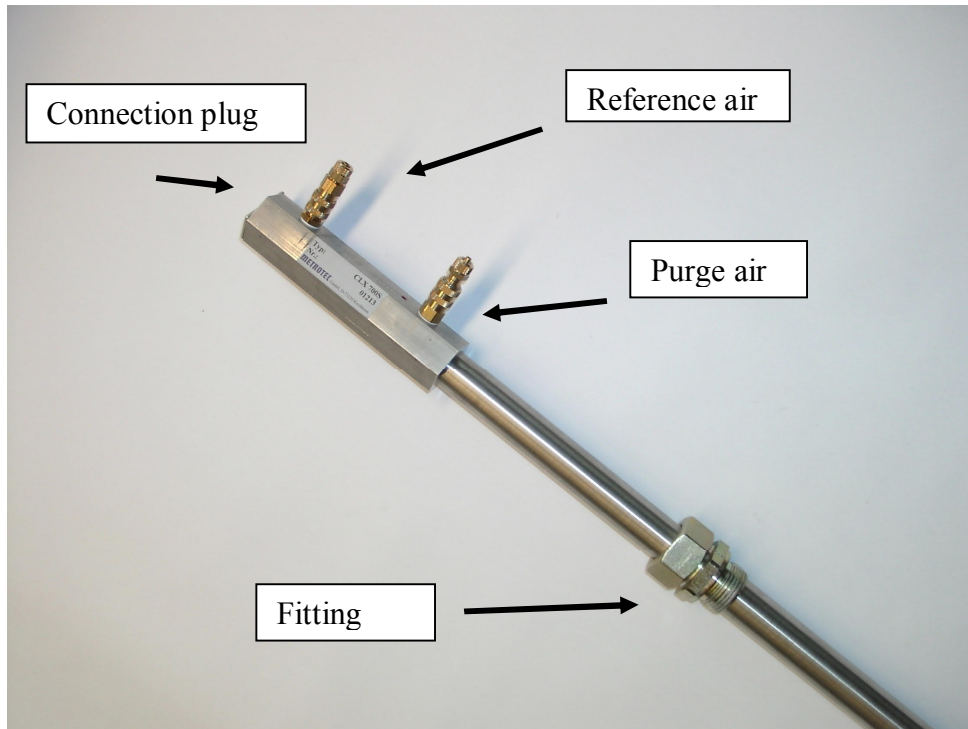
NOTE:

When installing or dismantling the sensor, make sure not to twist the head so as to prevent destruction of the sensor.



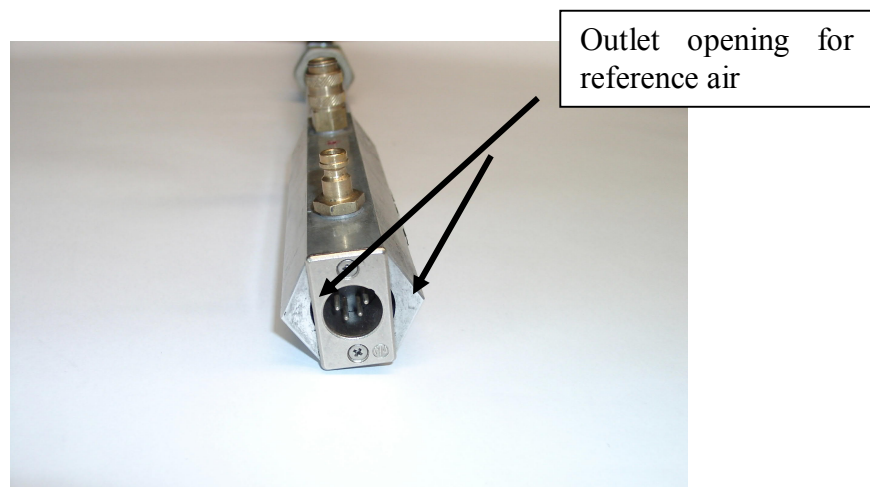
The clamping ring attachment (1 inch G) makes it possible to adapt the installation length as desired.

6 Connections



6.1 Reference Air

It is recommended to supply more than 500 mm long sensors with 30 l/h reference air. This air should contain no oils, grease, and / or water.



6.2 Purge Air

To clean the electrodes, the sensor may be supplied with approx. 50 l/h scavenging air. This air will incinerate any soot that may stick to the measuring electrode, thus cleaning it. During this procedure, the measured value cannot be evaluated for measuring purposes. Appropriate steps should be taken for the controls.

The frequency of scavenging air supply depends on the respective process and should be adjusted correspondingly.

6.3 Electric Signals

The sensors give rise to E.M.F. voltage as a signal for the partial oxygen pressure as well as thermoelectric voltage from an S type thermocouple (Pt10PtRh). It should be noted that the minus terminal of the thermocouple is connected to the plus terminal of the E.M.F.. Thus, the gating electronics should not be used with connected minus entry points.

7 Connection Plan

Sensor Plug		Metrotec Connection Cable VPK-S
Pin 1	EMF -	blue
Pin 2	EMF +	orange
Pin 3	Thermocouple -	white
Pin 4	Thermocouple +	red