METROTEC

Systems for oxygen measurement

Operating Manual

# A19

Oxygen Sensor

**Type A19**

*** Version 2.5 ***

**EC Declaration of Conformity**

for

Oxygen sensor Type A19 series

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. 1210027736 TMS*

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

Kirchheim/Teck, 31.03.2025

Place, date Signature


**Heinkelstraße 12 • D-73230 Kirchheim**
**Telefon 07021/95336-0 • Fax 07021/95336-13**
**www.metrotec.eu • info@metrotec.de**

# Table of Contents

# 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 Preface

Oxygen sensor work at high temperatures and so it is necessary for measures to be taken to ensure that no flammable gas mixtures contact the sensor or the unit. In the event of the sensor ceramic suffering breakage the measurement gas could escape or air could enter the measurement gas side of the unit and so suitable measures have to be taken to avoid such an event leading to environmental pollution or damage being done to equipment.

**In the event of incorrect parameters being set or the occurance of leakage, corrosion, condensation, etc., damage could be done to the equipment and incorrect measurement results be indicated and so it is essential that all parts of equipment be regularly serviced.**

*The oxygen sensor and its accessories are subjected to thorough quality control in accordance with DIN ISO 9001 in the course of their manufacture and testing.*
*They must only be installed and used in compliance with all applicable local and special regulations, particularly the VDE and DVGW standards that apply in Germany.*
*The measurement accuracy and effective function of the measurement device will need to be checked at intervals whose frequency will depend on the application concerned. Such a check must be effected in the course of a calibration and examination check on the equipment being first put into operation.*

# 3 Measurement principle

Oxygen measurement units are designed to process signals transmitted from an oxygen sensor constructed of stabilized zirconium oxide. Zirconium oxide, a ceramic material that is also spoken of as a solid-state electrolyte, acts as an excellent oxygen-ion conductor when at a high temperature.
Within certain temperature limits, that depend on the doping of the material concerned, such ion conductors are able to fill empty spaces in their crystal lattice with oxygen ions. The oxygen ions occur against an electrically conductive surface that is generally of platinum.
The concentration of oxygen in a measurement gas is thus decisive for the extent of oxygen activity, and thus for the number of oxygen ions.
An oxygen sensor consists essentially of a solid-state electrolyte with a contact surface on both sides.
One side of the electrolyte is in contact with a reference gas such as air, and the other with the gas whose oxygen content is to be measured. The mechanical construction of the sensor prevents contact between the two gases so that there is no risk of their being intermixed.
Depending on the application concerned, heated or unheated sensors are used. Unheated sensors are generally used in furnaces while heated sensors are used for applications where the gas to be measured is at a temperature of less than around 600 degrees Celsius (the measurement principle necessitates the sensor being maintained at a temperature of not less than 500 - 650 degrees Celsius).
Heated sensors are maintained at a set temperature by an electronic temperature regulator that forms part of the electronic control unit. The temperature of both heated and unheated sensors as measured by the electronic control is an important parameter for inclusion in the calculation of the oxygen content (oxygen partial pressure) in accordance with the following equation:

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

whereby:

| | | |
|---|---|---|
| R | = | 8.31J/mol K |
| T | = | Temperature in Kelvin |
| F | = | 96493 As/mol |
| $P_1$ | = | Oxygen partial pressure on the reference side with 0.20946 bar |
| $P_2$ | = | Oxygen partial pressure on the measurement gas side |
| EMF | = | Electromotive force in Volts |

# 4 Introduction

## 4.1 Sensor


**Sensor A19-N / A19-NC**


**Sensor A19-P / A19-PC**

The sensor is built into a stainless steel body, which has an aluminium housing with plug connection serving as the connection head.
In principle the sensor can be mounted in any position. However, we recommend assemblies with the connection head positioned at the top. The connection head has a multi-pin plug, to which the connecting cable leading to the converter module is attached.

## 4.2 Converter module

The sensor requires a series U or Z converter module in order to function.
Please refer to the unit's operating instructions for additional information.

# 5 Assembly

## 5.1 Electrical


**Sensor head sensor A19-N / A19-NC / A19-P / A19-PC**

The electrical connection to a converter module is made via a assembled cable with M12 sensor plug.

## 5.2 Mechanical

The sensor in the version A19-N/NC can be screwed into the reaction chamber. It should be noted that the temperature at the sensor head does not exceed 80°C. The screw-in thread may need to be cooled.


**Sensor A19-N /A19-NC with screw-in thread M27 x 2 mm**


**Sensor A19-P /A19-PC with a measuring chamber**

The sensor in the version A19-P/PC is provided for extractive removal of the measuring gases.
The gas inlet of the sensor is connected to the system via the G3/8 inch connector. In some applications, the extraction of the gases must be realized through masonry or insulation. A metal or ceramic extraction tube is suitable.
In cases in which condensate formation can occur, the withdrawal must be moved upward to the sensor in order to avoid deposits of liquid in the sensor.

Via the G1/4 inch connection at the gas outlet a flow of 50-80 l/h through the sensor must be ensured.
There are several ways to force a gas flow:

1. Sufficient overpressure at the gas inlet versus the gas outlet.
2. Differential pressure within the plant. Gas inlet and gas outlet can then be connected to the plant
3. Installation of a gas pump at the gas outlet

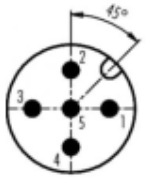
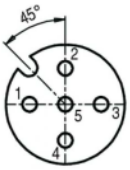
The installation of a flow meter and a needle valve for monitoring and adjusting the amount of gas in the gas lines can be helpful and necessary.

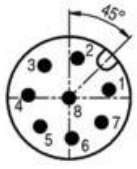
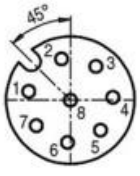
## 5.3 Custom designs

The sensor A19-S has been designed for special applications. It can be flanged directly to the measuring chamber with an O-ring and two M4 screws.

**Sensor A19-S**

# 6 Wiring diagram

| Sensor A19-N, A19-P, A19-S | | | |
|---|---|---|---|
| Cable | Pin | Function | Definition |
| Sensor module M12-4P,CodeA (f) | 1 | Sensor - | Sensor signal EMF - |
| | 2 | Sensor + | Sensor signal EMF + |
| | 3 | Heating | Sensor heating |
| | 4 | Heating | Sensor heating |
| **Pin numbering** | | | |
| Type | Plug | | Socket |
| M12-4P,CodeA |  | |  |

| Sensor A19-NC, A19-PC | | | |
|---|---|---|---|
| Cable | Pin | Function | Definition |
| Sensor module M12-8P,CodeA (w) | 1 | Sensor - | Sensor signal EMF - |
| | 2 | Sensor + | Sensor signal EMF + |
| | 3 | Heating + | Sensor heating + |
| | 4 | | |
| | 5 | Sense + | Sense + |
| | 6 | Heating - | Sensor heating - |
| | 7 | | |
| | 8 | Sense - | Sense - |
| **Pin numbering** | | | |
| Type | Plug | | Socket |
| M12-8P,CodeA |  | |  |

# 7 Specifications

**Sensor A19-N / A19-NC**

| | |
|---|---|
| Measuring range | 100 % up to 10 exp. -35 bar O2 |
| Ambient temperature | -10 to 80 degrees Celsius |
| Max. sample gas temperature | 200 degrees Celsius |
| Measuring accuracy | + 0,5 mV EMF sensor at least -0,5 ppm<br>- 2,5 mV EMF sensor at least 2 ppm |
| Sensor heating-up time | ca. 5 minutes |
| Measuring speed | ca. 2 seconds |
| Weight | ca. 1 kg |
| Connection head dimensions | Diameter ca. 70 mm, Height 75 mm incl. plug |
| Mounting depth | 30mm incl. thread, Diameter 20 mm |
| Screw-in thread | M27 x 2 mm |

**Sensor A19-P / A19-PC**

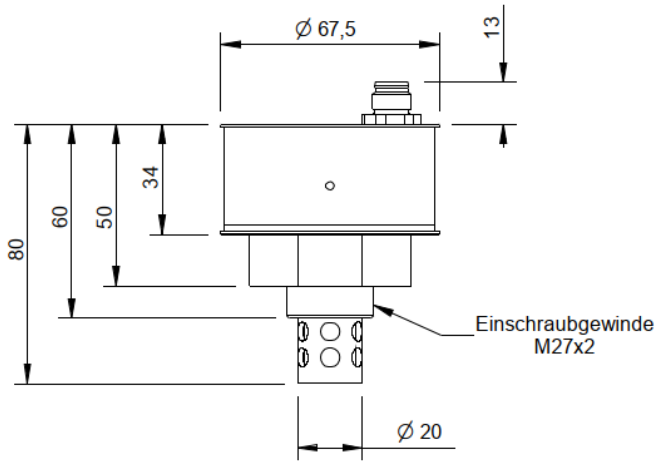
| | |
|---|---|
| Measuring range | 100 % up to 10 exp. -35 bar O2 |
| Ambient temperature | -10 to 80 degrees Celsius |
| Max. sample gas temperature | 200 degrees Celsius |
| Measuring accuracy | + 0,5 mV EMF sensor at least -0,5 ppm<br>- 2,5 mV EMF sensor at least 2 ppm |
| Sensor heating-up time | ca. 5 minutes |
| Measuring speed | ca. 2 seconds |
| Weight | ca. 1,5 kg |
| Connection head dimensions | Diameter ca. 70 mm, Height 75 mm incl. plug |
| Measuring gas inlet | G ⅜ inch |
| Measuring gas outlet | G ¼ inch |
| Measuring gas flow | 50 to 80 l/h |
| Mounting | at the side with 2 screws M5 |

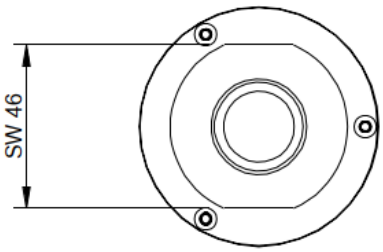
## Sensor A19-S

| | |
|---|---|
| Measuring range | 100 % up to 10 exp. -35 bar O2 |
| Ambient temperature | -10 to 80 degrees Celsius |
| Max. sample gas temperature | 200 degrees Celsius |
| Measuring accuracy | + 0,5 mV EMF sensor at least -0,5 ppm<br>- 2,5 mV EMF sensor at least 2 ppm |
| Sensor heating-up time | ca. 5 minutes |
| Measuring speed | ca. 2 seconds |
| Weight | ca. 1 kg |
| Connection head dimensions | Diameter ca. 70 mm, Height 75 mm incl. plug |
| Mounting depth | 30 mm, Diameter 20 mm |
| Mounting | M 4, cf. section "Special designs" |

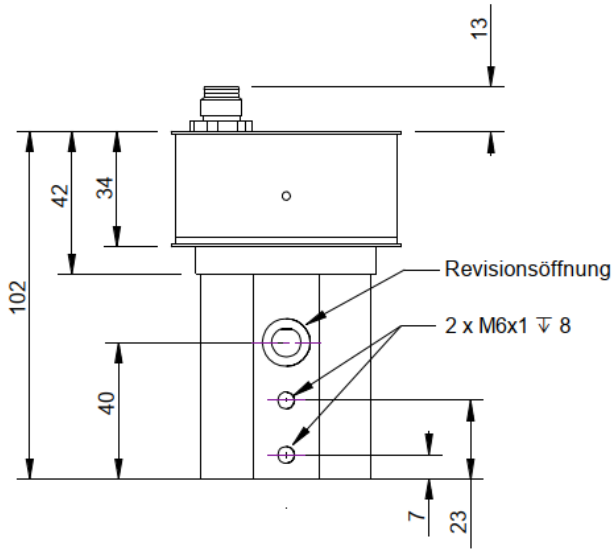
# 8 Dimensions

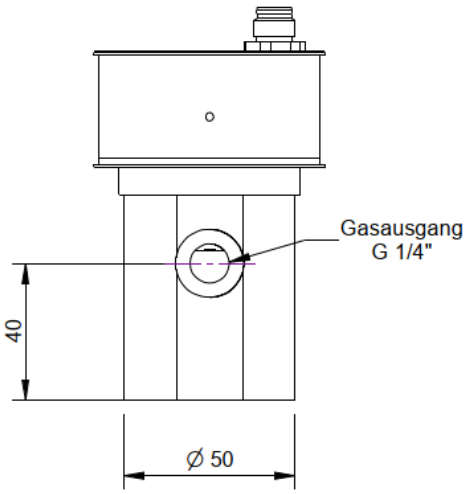
## 8.1 A19-N / A19-NC

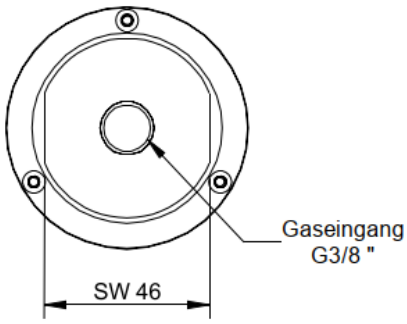



## 8.2 A19-P / A19-PC



## 8.3 A19-S