Technical documentation

Operating instructions

SE-O2-40

Documentation 2024-08-21

SE-O2-40	**O2 sensor Standard measuring range**
SE-O2-40AZ	**O2 sensor Standard measuring range with display**
SE-O2-40MA	**O2 sensor with 4-20mA output**
-O2-SMB	**Special measuring range**

TABLE OF CONTENTS

1 General information

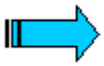
1.1 Notes on the operating instructions

These operating instructions describe the design, function and operation of all available variants of the O2 sensor.

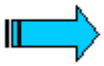
The manufacturer guarantees that these operating instructions have been prepared in accordance with the functional and technical parameters of the O2 sensor supplied. These operating instructions are not subject to the modification service. If the manufacturer makes changes to the O2 sensor in line with technical progress, the user is responsible for categorising the additional or updated pages supplied.

Trouble-free and functional operation of the O2 sensor can only be guaranteed with knowledge of these operating instructions.

All brand and product names are trademarks or registered trademarks of their respective owners.

 **Note**	**Therefore, read all sections of these operating instructions thoroughly before installing and connecting the O2 sensor.**

Pages, tables and illustrations are numbered consecutively.

 **Note**	**Cross-references are included in the text to lead the reader to more detailed or supplementary information.**

1.2 Symbols used

Important safety instructions in these operating instructions are identified by symbols. Always follow the instructions to avoid accidents, personal injury and damage to property.

Symbol for imminent danger

 **DANGER!**	**You will find this symbol next to all instructions on occupational safety if there is an immediate danger to the life and health of persons.**

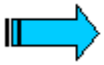
Failure to follow these instructions can result in serious or fatal injuries.

Symbol for imminent danger

 **ATTENTION!**	**This symbol indicates situations in which indirect hazards occur.** **The degree and intensity of the injury depend on the sequence of events triggered and the behaviour of the person concerned.**

Failure to observe these instructions may result in damage to or destruction of the entire O2 sensor or individual components, other property and minor injuries.

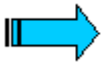
Symbol for proper handling

 **Note**	**This symbol is used in places in these operating instructions where reference is made to compliance with guidelines, regulations and correct work procedures.**

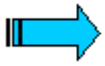
If these instructions are not followed, the O2 sensor or its individual components may be damaged or destroyed.

1.3 Copyright protection

The operating instructions must be treated confidentially. They are intended exclusively for persons working on and with the device. The operating instructions may not be passed on to third parties without the written consent of the manufacturer. If required, please contact the manufacturer.

 **Please note!**	**The content, texts, drawings, images and other illustrations are protected by copyright and are subject to further industrial property rights. Any misuse is punishable by law.**

1.4 Warranty and liability

 **Note**	**Guarantee and warranty claims are only accepted in accordance with the provisions of the manufacturer's "General Terms and Conditions of Delivery and Payment".**

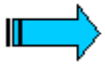
Guarantee and warranty period for the measuring cell: 12 months after delivery

Warranty and liability claims for personal injury and/or damage to property are excluded if they are attributable to one or more of the following causes:

- **Natural wear and tear**
- **No intended use of the O2 sensor**
- **Disregarding the provisions of these operating instructions**
- **improper installation, commissioning, operation and maintenance of the O2 sensor**
- **Operation of the O2 sensor with ineffective protective measures**
- **Unauthorised functional and technical modifications to the O2 sensor**
- **Removal of parts or installation of spare parts or additional devices that were not supplied or authorised by the manufacturer**
- **improperly carried out repairs or incorrect operation**
- **External influence and force majeure**
- **Damage to the seals**

All information and instructions in these operating instructions have been compiled taking into account the applicable regulations, the current state of engineering development and our many years of knowledge and experience.

The actual scope of delivery may differ from the explanations and drawings described here in the case of special versions, the utilisation of additional ordering options or due to the latest technical changes. If you have any questions, please contact the manufacturer.

 **Note**	**These operating instructions must be read carefully before starting any work on and with the appliance, especially before commissioning! The manufacturer accepts no liability for damage and malfunctions resulting from non-compliance with the operating instructions.**

The operating instructions must be kept directly on the device and accessible to all persons working on or with the device. The transfer of the operating instructions to third parties is not permitted and may result in compensation for damages. Further claims reserved.

We reserve the right to make technical changes to the device in order to improve its performance characteristics and for further development.

1.5 EU conformity

We, the company

Rudolf-Diesel-Str. 17-19
51674 Wiehl
Germany

declare under our sole responsibility that the product

Description: **Oxygen sensor**
Type: **SE-O2-40**
SE-O2-40AZ
SE-O2-40MA

with the requirements of the standards

- **EN 61000-6-3:2007+A1: 2011 Emission**
- **EN 61000-6-2:2005 Interference immunity**
- **EN 61326-1:2013-07 Interference immunity**
- **EN61326-2-3:2013-07 Transducer**

and therefore complies with the provisions of EC Directive 2014/30/EU (Electromagnetic Compatibility (EMC) Directive).

Gummersbach, 12.02.2015
Place and date of the exhibition

P. Jaspert (Managing Director)
Name, legally binding signature

The device was tested in a typical situation.

Any changes not agreed with us will invalidate this declaration.

(This declaration corresponds to EN 45 014)

2 Safety instructions

The following safety instructions provide general information on possible hazards when operating the O2 sensor. They must therefore be observed and strictly adhered to by the responsible personnel.

- Trouble-free and functional operation of the O2 sensor can only be guaranteed if you are familiar with these operating instructions. Therefore, please read all sections of these operating instructions thoroughly before installing and connecting the O2 sensor.
- The O2 sensor may only be used for its intended purpose (see chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**).
- The O2 sensor may only be connected, operated and maintained by trained personnel.

 **DANGER!**	**The sensor may only be used for the applications specified in the technical description and only in conjunction with third-party devices and components recommended or approved by STANGE.** **Correct and safe operation of the product requires proper transport, storage, installation and assembly as well as careful operation and maintenance.**

 **DANGER!**	**The use of the O2 sensor in potentially explosive atmospheres and theThe use of the O2 sensor in potentially explosive atmospheres and the introduction of explosive gas mixtures into the device is not permitted.** **An explosion-proof version is available.**

 **DANGER!**	**Removing or damaging the seals or opening the housing cover of the O2 sensor is not permitted. (This will invalidate the warranty on the sensor and its function)**

 **DANGER!**	**The sensor must be disconnected from the operating voltage before disassembly/assembly.**

Special safety instructions on possible hazards during a specific activity or sequence of activities are given at the relevant point in the text.

2.1 Responsibility of the operators

The sensor may only be operated in a technically perfect and operationally safe condition.

In addition to the occupational safety instructions in this operating manual, the generally applicable safety and accident prevention regulations for the area of application of the sensor as well as the applicable environmental protection regulations must be observed and complied with.

The operator and the personnel authorised by him are responsible for the trouble-free operation of the sensor and for clearly defining the responsibilities for installation, operation, maintenance and cleaning.

Follow the information in the operating instructions completely and without restriction!

The operator must also ensure that

- all further instructions and safety instructions resulting from the risk assessment of the workstations at the sensor are summarised in an operating manual in accordance with the German Ordinance on the Use of Work Equipment.
- these operating instructions are integrated into the system documentation.
- maintenance and inspection intervals are adhered to.
- The device, operating materials and waste products generated during production must be disposed of in an environmentally friendly manner and in accordance with legal regulations.

2.2 Repair

Repairs to the sensor may only be carried out by STANGE Elektronik GmbH. In this case, please contact the technical support of STANGE Elektronik GmbH.

No liability is accepted for any modifications to the device that are not described in this document.

2.3 ManufacturerAddress

Manufacturer:

STANGE Elektronik GmbH
Rudolf-Diesel-Str. 17-19
51674 Wiehl
Germany

Tel.: **+49 (0)2261 - 95790**
Fax: **+49 (0)2261 - 55212**
e-mail: **info@stange-elektronik.de**
Homepage: **www.stange-elektronik.de**

Responsible

STANGE Elektronik GmbH Thuringia office
Wandersleber Str. 1b
99192 Apfelstädt
Germany

Tel: **+49 (0)36202 75090**
Fax: **+49 (0)36202 750991**

2.4 Technical support

Support: **e-mail:** **support@stange-elektronik.de**

3 Transportpackaging and storage

3.1 Waste disposal

Stange Elektronik GmbH is responsible for the environmentally friendly disposal of old appliances. We will dispose of the devices if they are delivered free to the manufacturer's address stated above. Alternatively, please contact a certified disposal company for electronic waste.

Materials:

- Housing: aluminium, stainless steel
- Printed circuit board: 1st quality

3.2 Transport

Check the delivery immediately upon receipt for completeness and transport damage.

In the event of externally recognisable transport damage, do not accept delivery or only accept delivery with reservations. Note the extent of the damage on the transport documents/delivery note of the carrier. Initiate a complaint.

Complain in writing about hidden defects as soon as they are recognised (at the latest within 8 days (date of receipt)), as claims for damages can only be asserted within the applicable complaint periods.

3.3 Packaging

The packaging is an essential part of the product. The packaging is developed by the manufacturer individually for each product. In the event that you need to send your device for servicing or customer service during the warranty period or thereafter, only use the original packaging to transport the device. For this reason, you should keep the original packaging for as long as you have the appliance in your possession. If you wish to dispose of the packaging, we are obliged to take it back in accordance with the provisions of the German Packaging Ordinance and must ensure that it is either recycled or reused.

3.4 Storage

Keep the packages closed until assembly and observe the external installation and storage markings.

When not in use, the appliance must be stored in a dry, dust-free room.

4 Intended use

The main area of application of the O2 sensor is the control of protective gases in hardening processes and vacuum processes.

Typical applications of the O2 sensor are

- **Continuous measurement and display of the residual oxygen content in the vacuum**
- **Measuring the concentration of free oxygen in inert gases**
- **Measurement of the concentration of bound oxygen in gas mixtures**
- **Signalling the deviation of the oxygen concentration from a specified target value**
- **Measurement of oxygen concentration in industrial, laboratory and protective gases**
- **Measurements in connection with the mixing, production and processing of special forming gases**
- **Control of production processes that have to run under inert gas**
- **Checking inert gases for purity**
- **Gas nitriding process**

 **DANGER!**	**Any use of the sensor that goes beyond the intended use and/or any other use is prohibited and is considered improper use. In particular, the use of the sensor as a replacement for protective devices as defined in the Machinery Directive (DIN EN ISO 13849-1) is not permitted.** **Claims of any kind against the manufacturer and/or its authorised representatives due to damage resulting from improper use of the sensor are excluded.** **The operator alone is liable for any damage resulting from improper use.** **Intended use also includes correct compliance with the operating ranges and the installation, operating and cleaning instructions.**

Suitable protective measures must be taken for special applications where a hazard could arise or for media that could damage the O2 sensor! In particular, the mechanical properties of the ceramic sensor element used in the O2 sensor must be taken into account!

Hazards that can damage or destroy the sensor:

- **Water / water vapour in high concentration**
- **Dynamic pressure changes**
- **Rapid temperature changes**
- **Harmful media not mentioned here**
- **Special dynamic properties of the medium**
- **Mechanical load**

Include the process stages that may take place before and after the actual process in the analysis!

In special cases, talk to the manufacturer about possible special solutions!

4.1 Options for protecting the sensor:

If there is a risk of pressure surges / pressure hammers occurring, please disconnect the sensor from the process during this time, e.g. using a valve.

Pressure surges also occur when liquids (water) are introduced into a heated oven, e.g. during pre- / post-oxidation. The ceramic sensor element is additionally thermally stressed by the penetrating water / vapour.

In this case, the sensor should be temporarily switched off completely. We recommend the following procedure:

1. The sensor is supplied with power via a relay contact or separate switch.
2. Approximately 15 minutes before the critical phase, this contact is opened, giving the sensor enough time to cool down. A cold sensor is relatively insensitive to large changes in temperature and pressure.
3. Approx. 5 minutes after the water has been introduced, the atmosphere is sufficiently saturated and the process has calmed down. The contact can now be closed again and the sensor is ready for operation again 5 to 10 minutes later.

In general, when using water (pre- / post-oxidation), it should be dosed carefully and with slowly increasing quantities in order to avoid a sharp increase in pressure.

The use of the O2 sensor is not permitted in connection with:

- **Halogens in high concentration**
- **Gases containing sulphur**
- **Dust pollution**

The requirements and limit values specified in the technical data must be complied with at all times!

5 Structure and function

5.1 Basic structure

The O2 sensor consists of a ceramic sensor element and downstream electronics in a common housing. The output signal of the SE-O2-40 is over the entire measuring range (-35 mV ... +1.5 V).

The sensor element consists, among other things, of doped zirconium dioxide with platinum contacts.

The design and contacting of the sensor element are patented.

A KF40 flange is provided for connecting the O2 sensor to the medium to be measured. A protective plate in the connection pipe protects the sensor element from excessive flow.

With oxygen sensors SE-O2-40MA (1*), the measuring range is converted into a linear signal. Where 20.6 ... 0 vol.% => 4-20mA. The special measuring ranges can be defined after consultation with the manufacturer (-O2-SMB).

The variant (SE-O2-40AZ) with display contains a display for showing the sensor output voltage and status information. This also allows the sensor to be used without a connected evaluation unit.

5.2 Function

The O2 sensor utilises the property of zirconium dioxide to emit an electrical voltage in the event of a partial pressure difference. to emit an electrical voltage.

The temperature of the sensor element is regulated to 600°C for this purpose.

The medium to be measured is brought to the sensor element by means of convection to the sensor element.

If the partial pressure of the medium differs from the partial pressure of the surrounding air, an electrical voltage is generated in the sensor element.

This can be calculated using the following approximation formula (according to Nernst):

$$U = - \ln (O2 / 20.64) * 18.81$$

resp.

$$O2 = 20.64 * e^{ (- 0.05317 * U)}$$

O2	Oxygen concentration in the sample gas (in vol. %)
U	Voltage (in mV)

Oxygen concentrations of less than 20.64% by volume (air) therefore result in a negative voltage.

The electronics decouple this voltage via an inverting impedance converter and make it available as a positive output signal with low impedance.

Accordingly, if the oxygen content greater than air, a negative output signal is emitted.

For oxygen sensors with a limited special measuring range , the mV signal is converted to 4-20 mA.

Example: 0.0 ppm O2 corresponds to 4 mA 1000 ppm O2 corresponds to 20 mA (1*).

5.3 Measuring accuracy

The measurement error is specified as < 3% in relation to the full-scale value.

This takes into account the manufacturing tolerances that are defined by the specific properties of the zirconium dioxide used and in connection with its contact.used and in connection with its contacting.

The zero pointi.e. the output voltage in ambient air, is in the range of +/- 1mV. See also (1*).

Deviations within this range are also due, for example, to the influence of local air pressure, air quality or the current weather situation.

If necessary, the deviations can be compensated for by setting up an offsets in the evaluation unit. Not for (1*) see chapter 7 "Maintenance and troubleshooting".

In practice, the repeat accuracy in particular is significantly higher.

While a 1% change in the oxygen concentration in ambient air corresponds to a voltage change of approx. 1 mV, the sensitivity in the ppm range is considerably higher. Here, even a 1ppm change in concentration corresponds to a voltage change of 1 mV!

At oxygen concentrations <10 ppm, however, the effects of external influencing factors should also be taken into consideration:

- Specific features of the production process (e.g. input materials)
- Temperature of the sample gas
- Composition of the sample gas

Especially in the presence of hydrogen - which is very reactive - the accuracy of the measurement cannot be guaranteed!

6 Commissioning

6.1 Installation

There must be no heat sources or devices in the vicinity of the installation site or devices that generate strong magnetic fields (e.g. powerful electric motors, transformers).

The conditions at the place of use must comply with protection class IP 20.

The preferred operating position of the O2 sensor is vertical (housing facing upwards/connection flange facing downwards). In a horizontal installation position, the sensor should be installed at an angle of at least 10° to prevent condensation from entering.

The O2 sensor is attached directly to the gas chamber or as close as possible to the process using a suitable KF40-counter flange directly on the gas chamber or as close as possible to the process. This requires a centring ring (also known as a sealing ring ring) and a clamping ring are required.

It must be ensured that the probe opening has free access to the gas chamber so that the convection flow from the sensor from the sensor inlet to the internal measuring cell.

Ensure that the vacuum flange is tight! The pipework should also only be vacuum-tight.vacuum-tight design. This is important for an accurate measurement result, because even with overpressure, traces of oxygen can still enter the sensor's measuring chamber via faulty threaded connections, for example.

The installation location must be selected so that no harmful turbulence occurs at the sensor inlet that could impair or prevent the formation of the convection flow (see also installation example).

The direct inflow of low-temperature media with a low temperature must be avoided in order to prevent a temperature shock in the ceramic sensor element and thus its destruction.

It is also essential to prevent water from penetrating into the hot sensor element, as this would destroy the sensor.

Illustration 1; clamping ring and centring ring for KF-40 flange

Illustration 2; O2 sensor without display

6.2 Assembly example

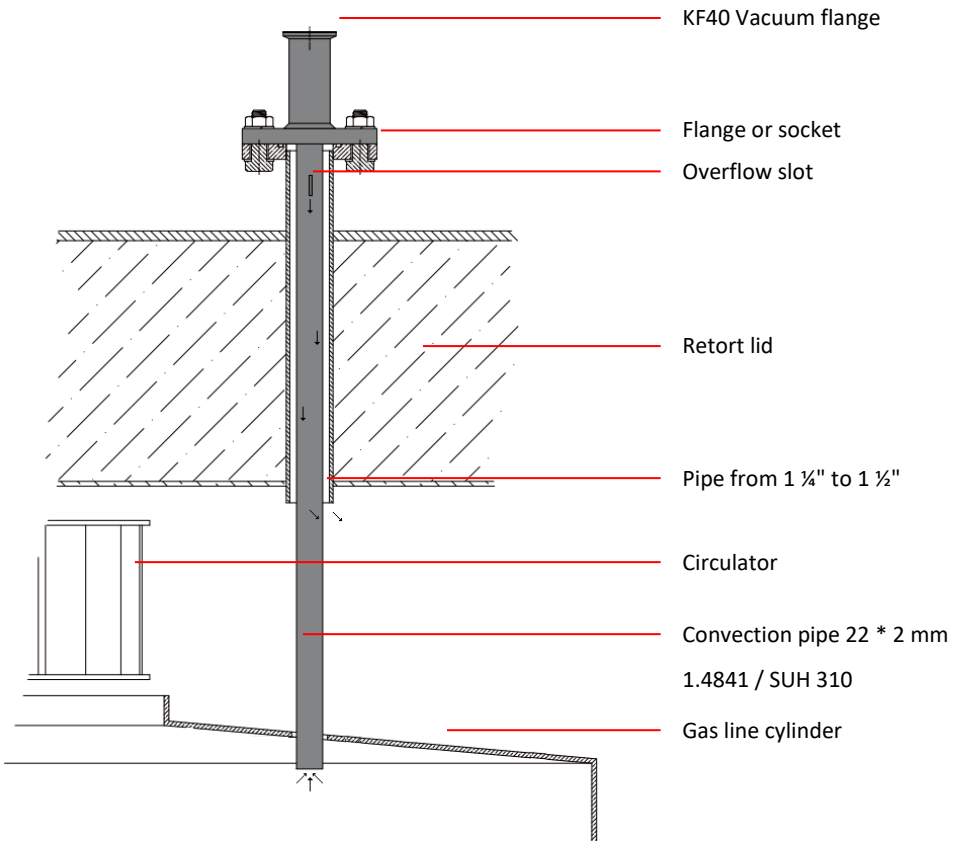


Illustration 3; Installation example via convection pipe

6.3 Electrical connection

A 24V /2A power supply unit is supplied for the O2 sensor. is supplied. The use of this power supply unit to supply the sensor is strongly recommended. This is the only way to prevent mutual interference with other components.

The O2 sensor is connected to the power supply via the 4-pin DIN 41524 round socket or a cable supplied.

Table 1Input voltage

Pin no.	Input voltage	Core colour
1	24 V_{DC}	Brown
2	GND	White

The DC voltage output -35mV ... +1.5 V or 4-20 mA (1*) output is connected to the V / mA input of an evaluation device.

Table 2Voltage/current output

Pin no.	Output voltage	Core colour
3	+ U_{out}	Green
4	- U_{out}	Yellow
	Current output (1*)	
3	+ mA_{out}	Green
4	- mA_{out}	Yellow

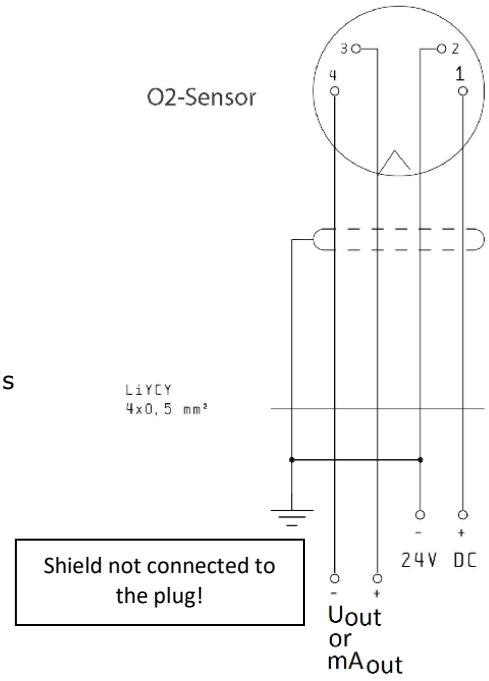


Illustration 4; DIN socket connection

6.4 Function check

When transporting from a cold environment to a location with a higher ambient temperature or humidity, a waiting time of at least two hours must be allowed for temperature equalisation before switching on the O2 sensor.

After the operating voltage is applied, the O2 sensor requires a maximum heat-up time of 20 minutes. Heating up is indicated by LED 1 (green) and LED 2 (red).

When the set temperature range is reachedLED 2 changes from red to orange.

The LEDs are omitted in the version with display. Temperature and status are permanently shown on the display.

The O2 sensor is now ready for operation. With ambient air (oxygenconcentration approx. 20.64% by volume) and normal pressure the output voltage should be in the range of +/- 1mV. Not with (1*).

7 Maintenance and troubleshooting

7.1 Maintenance

The electronics and the measuring cell are maintenance-free.

In the event of defects, the O2 sensor must be sent to the manufacturer for repair.

7.2 Troubleshooting

If the O2 sensor does not provide the required values, the user can carry out the following function tests can be carried out by the user. If these are not successful, the sensor must be sent to the manufacturer for inspection or repair. to the manufacturer for inspection or repair. If you attempt to repair the sensor yourself or damage the seals will invalidate the warrantyservice becomes void:

Heating, power supply:

After applying the operating voltage to a cold sensor, the LED 1 should light up green. This indicates the heating process. LED 2 lights up red. If there is a display, the heating symbol is shown and the displayed temperature value rises slowly.

After approx. 20 minutes of operation at the latest, the O2 sensor in the area of the flange shouldshould be noticeably warmer (warm to the touch). LED 2 indicates that the required temperature range has been reached by changing colour to orange. If a display is present the status display changes to "Ready".

Alternatively, the current consumption can also be measured via the operating voltage connection. It should be between approx. 400 and 900 mA.

If this is not the case, it is recommended to check all connections between the O2 sensor and the power supply and check the operating voltage of 24 V ... 26.4 V DC max. The measurement should be carried out with the O2 sensor connected both at the power supply and directly at the O2 sensor, if necessary with the connector plug open pins 1 and 2 of the O2 sensor. This can also be used to localise an excessive voltage drop via the supply line.

The operating voltage directly at the O2 sensor should not fall below 24 V ... 26.4 V DC max. and the polarity should correspond to the specifications under point 5.4.2.

Output signal:

For checking the zero point in atmosphere (air) see also point 6.1

"Function check" and sensor with special measuring range (1*)

If the expected values are not displayed on the analyzer during operation, the output signal of the O2 sensor should be checked with test gas.

This requires a conventional multimeter and a suitable test gas N_2 are required.

For example, it is sufficient to carefully allow some nitrogen to flow into the sensor head. into the sensor head. Other inert gases are also suitable. After a short reaction time an output signal of at least a few millivolts - depending on the gas used - should be measurable or visible on the display. The theoretical maximum value of 1500 mV cannot be achieved under terrestrial conditions.

8 Technical data

Table 3, Characteristic data

Designation	O2 sensor SE-O2-40 O2 sensor with display SE-O2-40AZ O2 sensor SE-O2-40MA(1*)
Use	Measurement of the oxygen concentration in gases
Measurement data	
Measuring range	0 to 100 vol.-% O_2 Special measuring range 0- xxxx ppm % O2 in 4-20 mA linear
Output signal	-35 mV to 1500 mV -35 mV corresponds to 100 vol.-% O2 0 mV corresponds to 20.64 vol.-% O2 (air) 1500 mV correspond to 0 vol.-% O2 20 mA corresponds to 0 ppm.-% O2 4 mA corresponds to 20.6 vol. % O2 -O2-SMB => Special measuring range according to agreement
Measuring accuracy at normal pressure	rel. Measurement error < 3 % in relation to the maximum output signal
Max. permissible pressure of the sample gas	3 bar
Min. permissible pressure of the sample gas	10^{-7} mbar
Leakage rate	< 10^{-7} mbar*l/s
Max. permissible temperature at the connecting flange	65 °C
Mechanical data	
Dimensions SE-O2-40	105 x 66 x 250 mm (W x D x H)
Dimensions SE-O2-40AZ	105 x 90 x 250 mm (W x D x H)
Dimensions SE-O2-40MA	105 x 90 x 250 mm (W x D x H)
Mass	1.0 kg
Gas inlet	Vacuum flange KF 40
Degree of protection	IP 20
Electrical connection	
Tension	24 V ... 26.4 V DC max.
Power consumption	24 VA
Heating measuring cell	approx. 18 V DC, approx. 10 W (internally regulated)
Ambient conditions	
Ambient temperature	min. 0 °C, max. 45 °C
Relative humidity	up to 80 % at 20 °C
Storage conditions	min. -20 °C, max. 60 °C rel. humidity < 95 % at 20 °C

8.1 Dimensioned drawing

Depth SE-O2-40	66 mm
Depth SE-O2-40AZ	90 mm
Depth SE-O2-40MA	90 mm

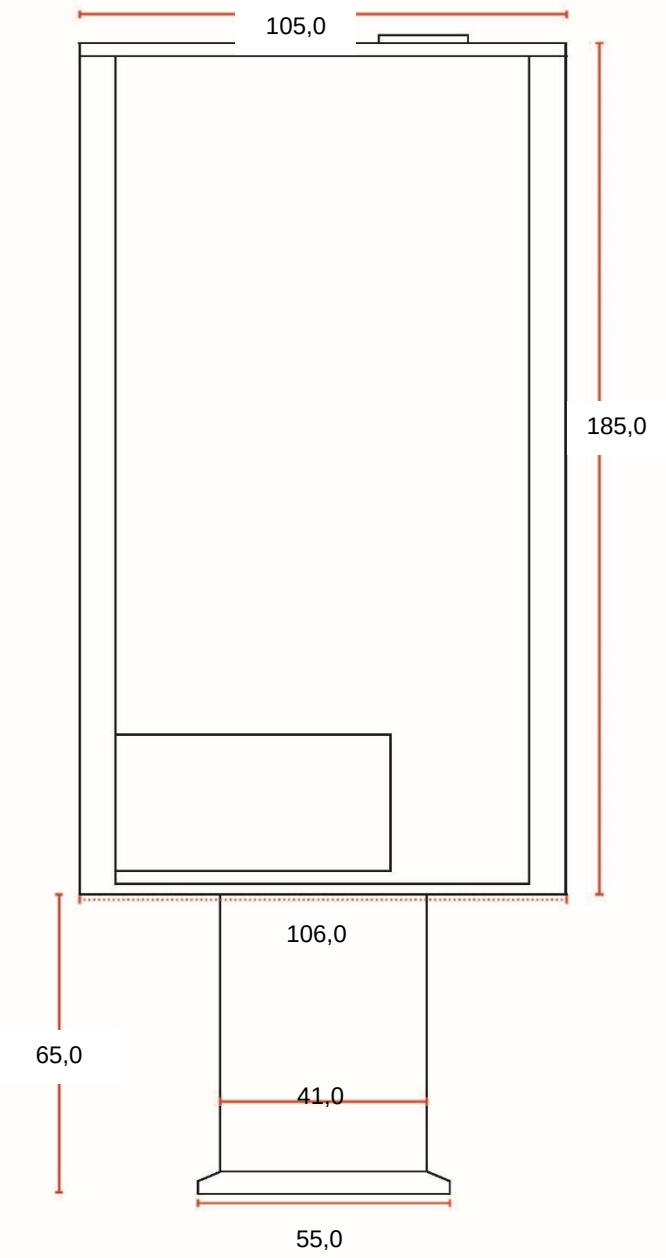


Illustration 5; Dimensional drawing

9 Figures, tables and index

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