

Operating Manual

Oxygen partial pressure sensor in specialized housing

GGO ..., GGA ..., GOO..., GOG / ResOx ...



-  Please read these instructions carefully before use!
-  Please consider the safety instructions!
-  Please keep for future reference!



WEEE-Reg.-Nr. DE 93889386

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1. Safety

1.1. General note

Read this document carefully and get used to the operation of the product before you use it. Keep this document within easy reach near the product for consulting in case of doubt.

Mounting, start-up, operating, maintenance and removing from operation must be done by qualified, specially trained staff that have carefully read and understood this manual before starting any work.

The manufacturer will assume no liability or warranty in case of usage for other purpose than the intended one, ignoring advices of this manual, operating by unqualified staff as well as unauthorized modifications to the product.

1.2. Intended use

The product is suitable for the measuring of gaseous oxygen, in conjunction with appropriate devices.

Dependent on the application, a suitable sensor-element must be chosen.

See also the specification at the end of the document.

Personnel which starts up, operates and maintains the device has to have sufficient knowledge of the measuring procedure and the meaning of the resulting measured values, this manual delivers a valuable help for this. The instructions of the manual have to be understood, regarded and followed.

To be sure that there's no risk arising due to misinterpretation of measured values, the operator must have further knowledge in case of doubt - the user is liable for any harm/damage resulting from misinterpretation due to insufficient knowledge.

1.3. Skilled personnel

Users of the readily installed product have to be sufficiently skilled in the operation of the product and able to avoid risks. The operator of the arrangement is responsible for sufficient qualification the operators.

1.4. Safety signs and symbols

Warnings are labelled in this document with the followings signs:

**Caution!**

This symbol warns of imminent danger, which can result in death, severe bodily injury, or severe property damage in case of non-observance

**Attention!**

This symbol warns of potential dangers or harmful situations, which can cause damage to the device or to the environment in case of non-observance

**Note!**

This symbol point out processes which can indirectly influence operation, possibly cause incorrect measurement or provoke unforeseen reactions at non-observance.

**Caution, acid!**

This symbol warns of danger to living tissue and many materials, that can be damaged or destroy by exposure to that chemical.

1.5. Safety guidelines

The fault-free function and operational safety of the product can only be guaranteed if applicable safety precautions and the device-specific safety instructions for this document are observed.

If these notices are disregarded, personal injury or death, as well as property damage can occur.

1. Faultless operation and reliability in operation of the measuring device can only be assured if the device is used within the climatic conditions specified in the chapter "Specifications".

2.



The product must not be used for diagnostic or other medical purposes on patients!

3.



The product is not suitable for use in explosion-prone areas!

4.



Do not use in safety / emergency stop devices!

Not suitable for use with requirements on functional safety, e.g. SIL!

5.



The product is not suitable for underwater use (rebreather)!

6.



The sensor contains **KOH** (GOEL 381) or **acid** (GOEL 370).

KOH and acid can cause severe chemical burns!

In case of leaking liquid, avoid contact at all costs!

In case of contact:

- with skin: wash off immediately with plenty of water for several minutes.
- with clothing: remove contaminated, soaked clothing immediately.
- with eyes: rinse under running water for several minutes, consult a doctor.

If swallowed:

- drink plenty of water immediately, DO NOT induce vomiting!
- consult a doctor.

7. When connecting the device to other devices the interconnection has to be designed most thoroughly, as internal connections in third-party devices (e.g. connection of ground with protective earth) may lead to undesired voltage potentials.

8.

**DANGER**

The product must be switched off and must be marked against using again, in case of obvious malfunctions of the device which are e.g.:

- Visible damage.
 - Device does not work like prescribed.
 - Storing the device under inappropriate conditions for longer time.
- When not sure, the product should be sent to the manufacturer for repairing or servicing.

9. Modifications or repairs of the product may not be performed by the customer.

10. If the device is transported from a cold to a warm environment condensation may result in a failure of the device. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.

2. Product description

2.1. Scope of supply

- Oxygen sensor in housing
- Operating manual

2.2. General information about application areas

GOEL 370 (acidic electrolyte): *Integrated in GGO 370, GGA 370, GOO 370 (for GMH 3690/91/92/95)
or in GGO 570, GGA 570, GOO 570 (for GMH 5690/95)*

Especially long life time of > 3 Years in Air.

Suitable sensor for diving application e.g. measuring Nitrox, recommended for the range of 0.2 ... 35 vol.-% O₂.

Also suitable to measure oxygen-concentration in air or other gases with a high CO₂-content or even in a CO₂-atmosphere. The acid electrolyte guarantees that the sensor could not be influenced by CO₂

GOEL 381 (basic electrolyte): *Integrated in GGO 381, GGA 381, GOO 381 (for GMH 3690/91/92/95) or in GGO 581, GGA 581, GOO 581 (for GMH 5690/-95)*

Sensor for low oxygen concentration near 0.0 and up to 100 vol.-% O₂. Especially for diving gases above 35 vol.-% O₂ the best choice.

For application without larger CO₂ concentration *)

*)



The GOEL 381 is designed to measure oxygen-concentration in air or other gases without larger CO₂ concentration. Higher CO₂-concentration reduces the life-time of the sensor.

Short-time exposition of up to 10% CO₂ is not problematic (for example 15 minutes. up to 10 times per day) for the GOEL 380 (e.g. exhaust measuring). If there is measured more often with elevated CO₂-concentration or at CO₂-concentrations above 10%, the exposition time has to be kept as short as possible and sufficient measuring breaks should be made



If the sensor is not exposed to free air during measuring pauses, the connected tubes etc. have to be flushed with clean air or nitrogen.

2.3. General information about the oxygen sensors

Lifetime: At the end of life time the sensor signal drops relatively fast. The electrode evaluation in % therefore just can be used for orientation. An evaluation of 70% does not mean that 70% of life time are remaining, but 70% of the reference signal are available, which happens normally at the end of life time. The nominal life time can be shortened significantly by usage. Influencing factors are:

- Storage- / Operation temperature
- Humidity of measured gas: If permanently used with dry gases (technical gases, bottled gas) the life time decreases considerably.



The electrode evaluation is updated by the instrument every time, when the calibration of the sensor was performed successfully. (please also see the referring manual of the instrument)

Operating position: The optimum operation position is with the sensor inlet pointing downwards, maximum differential pressure to ambient is 250 mbar.

Measuring precision: The measuring precision can be influenced by:

- Liquids at the sensor inlet. Rinse the inlet and dry with lint-free cloth. Attention: avoid liquids of any kind at the contacts
- Gas and sensor temperature have to be at same level. Best precision, when calibrated at measuring temperature.
- Pressure fluctuations: The sensor is originally a partial pressure sensor, i.e. changes in the absolute pressure are influencing the measuring result directly proportional. A pressure change of 1% will cause a additional measuring error of 1%!
For optimum precision calibrate at the same conditions at which You want to measure.

3. Application of the different sensor types

3.1. GGO housing (closed sensor)



For measurements at atmosphere and in systems without over or under pressure the GGO... is sufficient. Additionally the GGO can be screwed tightly into systems with small over or under pressure. Attention! Mind the maximum pressure and the maximum pressure difference at the membrane.

GMH 3690: Always calibrate and measure at the same pressure!

GMH 3691: If pressure during calibration and measuring differs, please enter its value manually.

GMH 3692/3695/5690/5695: if instrument and sensor pressure are identical, it will be compensated automatically.

3.2. GGO housing (open sensor)



The sensor is equipped with drillings at the end and because of its special construction the measuring gas streams optimally around the sensor. No pressure can appear while gas blows to the sensor, which otherwise would result in erroneous measures. The temperature compensation speed of the sensor also is optimized by this design.

Especially the measuring of gases from compressed gas bottles, where the expansion of the gas leaving the bottle lowers the temperature, is optimized with regard to the temperature compensation and pressure errors. The gas flow should be chosen in a suitable range, where no overpressure can happen, esp. if the sensor is connected directly to the source e.g. by means of a tube.

3.3. GGA housing (closed sensor with pressure connection)



If You use an instrument with pressure connection (e.g. GMH 3695), this type is optimal. Especially at **systems with over or under pressure** or at dynamic pressure due to gas flow. It can be screwed tightly into systems with small over or under pressure. Attention! Mind the maximum pressure.

The instrument pressure port is connected directly to the sensor port. Then the actual pressure at the membrane will be measured and compensated automatically.

3.4. GOG housing (ResOx Measuring)



The GOG / ResOx housings are specialized gas sampling devices, which are suitable to sample and analyse small gasprobes by means of a gas sampling pump. You get more informations in the referring GOG und ResOx set manuals

4. Measuring Oxygen with the GMH 369x and GMH 569x

Calibration and measuring are depending of the absolute pressure at the sensor.

Therefore check the absolute pressure before calibration and measuring. When using a GMH 3691 (with manual pressure compensation) the pressure can be entered, when using a GMH 3690 the pressure during calibration should be the same as during the measuring (otherwise e.g. 1% deviation results in 1% measuring error).

The GMH 3692 / 3695 / 5690 / 5695 have integrated automatic pressure compensation. There you only have to have in mind, that instrument and sensor membrane have the same pressure.

Sensor temperature and gas temperature should be the same.

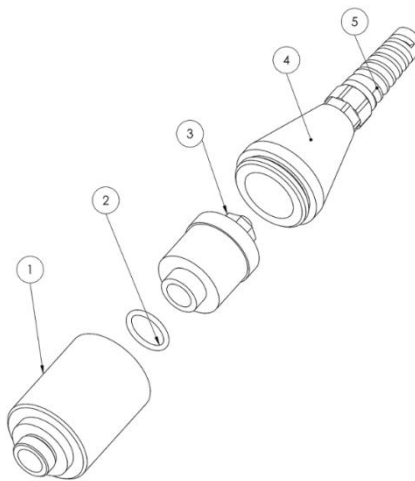
Temperature differences may cause additional measuring errors! In worst case conditions it may take up to several hours until both temperatures are adjusted. A suitable flow of the gas around the sensor element increases the adjustment significantly.

5. How to operate

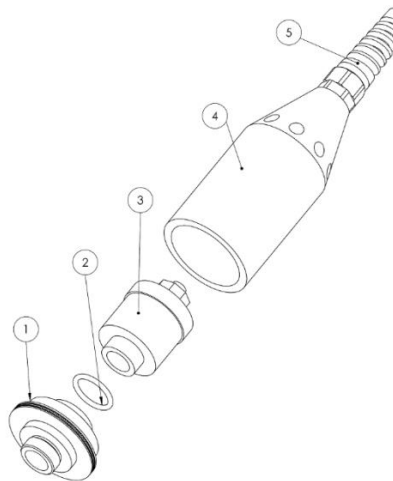
- Treat device and sensor carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plug and socket from soiling.
- The sensors are only suitable for the devices of the GMH 369x or GMH 569x series. Unsuitable devices may lead to the destruction of the measuring device and the measuring sensors.
- When connecting the sensor to a GMH 369x the connector may not lock to the jack correctly. In such a case hold the connector not at the case but at the buckling protection of the cable during the plug in.
- Don't connect sensor canted! If plug is entered correctly, it will slide in smoothly.
- To disconnect sensor do not pull at the cable but at the plug.
- Keep the allowable pressure range of the sensor in mind, too high or too low pressure may destroy the sensor.

6. Exchanging the sensor element

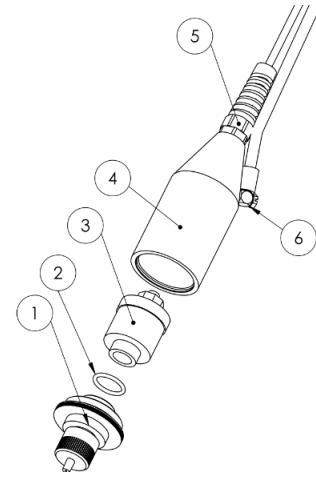
The sensor housings are consisting of two halves (1) and (4) and can be opened by screwing up:



GGO/GGA housing



GOO housing



GOG / ResOx 5695 housing

Changeable part is the sensor element (3). Important when reassembling:

- First screw in sensor (3) in part (1). Do not forget O-Ring (2). Unscrew the sensor carefully e.g. by means of suitable nippers.
- The audio plug of part (4) has to be connected to the socket in the sensor. If this makes problems, the cable gland (5) can be opened so that the cable can be shifted further into part (4), until the plug can be connected.
- After that screw together (1) and (4) tightly, if necessary retighten the cable gland (5).

7. Decommissioning, reshipment and disposal

7.1. Decommissioning

Please also make sure that connected Loads are disconnected also and are in a safe state.

7.2. Reshipment and disposal



All devices returned to the manufacturer have to be free of any residual of measuring media and other hazardous substances.
Measuring residuals at housing or sensor may be a risk for persons or environment



Use an adequate transport package for reshipment, especially for fully functional devices. Please make sure that the device is protected in the package by enough packing materials.
Add the completed reshipment formula of the GHM website



The sensorelement must not be disposed in the unsorted municipal waste! Send the sensor directly to us (sufficiently stamped), considering the above if it should be disposed.
We will dispose the device appropriate and environmentally sound.

8. Specification

(All specification basis on environment of 25°C, 50 %RH and 1013 hPa)

Sensor for GMH 369x-Series: for GMH 569x-Series:		GOEL 381 GGO 381, GOO 381, GGA 381 GGO 581, GOO 581, GGA 581	GOEL 370 (Rev 2) GGO 370, GOO 370, GGA 370 GGO 570, GOO 570, GGA 570
application		Diving gas *1) precise measuring at low O₂ (e.g. <0.5 vol.-% O₂) or concentrations above 35 vol.-% O₂	Diving gas *1) Protection gases with CO₂ concentrations and O₂ concentrations below < 35 vol.-% O₂
Permanent operation with high CO ₂ -concentrations		-	+++
Short time exposition to CO ₂ *2)		+	+++
Use up to 100 vol.-% O ₂		+++	-
Use below 0.2 vol.-% O ₂		+++	+
Speed /t ₉₀		++ / <10s	++ / <10s
Lifetime hours per vol.-% O ₂ / at air		+/500 000 %h/ >2 years	++/1 200 000 %h/ max. 6 years
Diving gas application *1)		+++	+++
Meas. ranges	O ₂ partial pressure	0 ... 1100 hPa	0 ... 350 hPa
	O ₂ concentration	0.0 ... 100.0 vol. % O ₂	0.0 ... 35.0 vol. % O ₂ (lower accuracy above)
Accuracy:	< 35 vol. % O ₂	±0.25 vol. % O ₂	-0.2 ... +0.35 vol. % O ₂
	35 - 100 vol. % O ₂	±0.25 vol. % O ₂ *2)	not specified
Electrolyte:		basic	acidic
Connection:		approx. 1 m cable. Temperature sensor integrated	
Storage temperature:		-15 to +60 °C	
Operating ambient		0 ... +45 °C	
Ambient pressure:		0.6 ... 1.75 bar abs.	
Over-/under pressure:		max. 0.25 bar (pressure difference sensor membrane to ambient – sensor screwed-in)	
Material in contact media		PA, PPS, PTFE, stainless steel	ABS, PPS, PTFE, stainless steel, NBR
Cross sensitive		No to He, H ₂ und CO	<20 ppm O ₂ response to 100 % Vol. % CO , 100 % Vol. % CO ₂ 100 % Vol. % C ₃ H ₈ 1000 ppm Benzene balance N ₂ 3000 ppm NO ₂ balance to N ₂ 1000 ppm H ₂ balance to N ₂ 2000 ppm H ₂ S balance to N ₂ 1000 ppm SO ₂ balance to N ₂
Warranty period:		12 months (assuming appropriate usage according to the manual)	
Weight:		approx. 135 g (GGO...) or approx. 145 g (GOO, GGA...)	
Dimension:		GGO, GGA: approx. Ø 36 mm x 95 mm (150 mm incl. anti-buckling glanding), GOO: approx. Ø 40 mm x 105 mm (160 mm incl. anti-buckling glanding) Housing with M16 x 1-screw thread (sensor can be connected to line tubes by means of an additional adapter)	
Directives:		The product conform to the following Directives of the Council for the harmonisation of legal regulations of the Member States 2011/65/EU, incl. 2015/863 RoHS 2 and RoHS 3 Applied harmonised standards: EN IEC 63000:2018	

*1) Sensors are not allowed to use in „under-water-diving-application“ (e.g. Rebreather)

*2) please refer chapter 2.2