ZIROX
Sensoren und Elektronik GmbH

ZIROX - Oxygen Measuring Systems

SGM7.2.4
SGM7.2.6

Oxygen Measuring Device
For
Reflow Soldering Systems

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Manual

Oxygen Measuring Device

For

Reflow Soldering Systems

Range: $2 \cdot 10^5$ ... 10 vol-ppm

Power supply: 100…240 V, 47…63 Hz

Operating hour counter

Indication of maintenance interval for filter change

(depends on pump mode)

Table of contents

1 General information

1.1 Introduction

This operation manual describes the composition, mode of operation and use of the oxygen monitor SGM7.2.4 of ZIROX Sensoren und Elektronik GmbH.

If not particularly marked, the specifications are valid for the SGM7.2.6 as well.

Address of manufacturer:

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The manufacturer guarantees that this manual was written in accordance with the functional and technical features of the delivered SGM7.2.4.

This manual is not subject to the amendment service. If the manufacturer modifies the SGM7.2.4 with the aim of making technical improvements, the user is responsible for inserting the additional or updated pages supplied.

Proper operation of the SGM7.2.4 can only be ensured if the contents of this manual are known. Therefore, all chapters of this manual must be read carefully prior to operating the SGM7.2.4.

The values on the device display in this manual are examples or preset parameters of the manufacturer. The user must set process-specific parameters.

Pages, charts and figures are numbered consecutively.

1.2 Copyright

1.3 Commonly used symbols

Symbol for imminent danger:

This symbol refers to imminent danger to persons' life and health.

In case of disregard, fatal injuries may result.

Symbol for indirect danger:

This symbol indicates indirect danger.

The degree of the damage depends on the circumstances and the actions of the persons involved.

In case of disregard, destruction or damage of the SGM, its single components or other material assets as well as minor injuries may result.

Symbol for proper handling:

NOTE

This symbol appears where the manual refers to the adherence to rules, instructions and proper operation.

In case of disregard, damage or destruction of the SGM or its single components may result.

2 Application field

Designate use

The protective gas monitor SGM7.2.4 serves the continuous measuring of the oxygen concentration in industrial, laboratory and protective gases as well as in the process of mixing and producing of special forming gases in industry. The measuring of the free oxygen concentration in inert gases and also the measuring of bound oxygen in gas compounds is possible.

The main application fields of the oxygen monitor are:

- processes for mixing and producing of forming gases
- production processes of welding and soldering, especially gas-shielded arc welding in steel and container production as well as plant construction
- production processes of electronic components under buffer gas.

The introduction of explosive gas compounds, high concentrations of halogens or sulphuric gases (e.g. SO_2) into the SGM7.2.4 is not permitted.

The contact of the SGM7.2.4 with siliconic or phosphoric compounds is not permitted either.

Functions

The SGM7.2.4

- measures and indicates the oxygen concentration in a measuring gas continuously;
- indicates any deviations of the oxygen concentration in the measuring gas from an adjustable set value;
- monitors the course of a particular production process under buffer gas;
- checks the purity of buffer gases and determines whether the requested protective effect of the buffer gas is reached.

The requirements and limit values provided in "Technical data" must be strictly observed.

Any other use is treated as non-authorized use.

3 Safety regulations

The following regulations for industrial safety provide basic information about potential danger during the operation of the buffer gas monitor SGM7.2.4. Therefore, they must be observed and strictly followed by the responsible staff.

- A failure-free and functional operating of the SGM can only be guaranteed with knowledge of this manual. Therefore, all chapters of this manual must be read carefully before the installation and initiation of the SGM.
- The SGM is to be used for the functional operation only (see chapter 2).
- The SGM is to be installed, operated, and serviced by trained staff only.
- The SGM is to be connected to an isolated ground socket (Schuko-socket) with the supplied cable.

Explosive gas compounds, halogens in high concentration, and sulphuric gases (e.g. SO_2) are not permitted to be measured by this SGM7.2.4.

Due to the high operation temperature of the sensor, the SGM produces a lot of heat.
Make sure the device does not overheat because of covering.

A vertical installation may cause heat accumulation and damage to the device.

Switch off and disconnect the device from the power supply before opening the housing cover of the SGM.

Special safety instructions for potential danger during certain working processes are given in relevant text passages.

4 Functional description

4.1 Measuring principle

In industry and laboratories, the measurement of the oxygen concentration in gases is often required. Mostly, it is measured in gases, which have a considerable, temperature-independent oxygen concentration.

The NERNST equation is used as a basis for determining the oxygen concentration in gases with the oxygen monitor SGM7.2.4. *NERNST equation*

$$U = \frac{RT}{4F} \ln \frac{p_{O2,\,air}}{p_{O2,\,meas.\,gas}} \quad \textbf{(I)}$$

U – cell voltage in V

R – molar gas constant, R = 8.314 J/(mol · K)

T – measuring temperature in K

F – Faraday-constant, F = 9.648 · 10^4 C/mol

$p_{O2,\,air}$ – partial pressure of the oxygen at the reference electrode in dry air in Pa

$p_{O2,\,meas.gas}$ – partial pressure of the oxygen at the measuring electrode in the measuring gas in Pa.

The sensor of the SGM7.2.4 is based on the conductivity of oxide ions in a special ceramic substance (zirconium dioxide) with stabilizing additions. The conductivity of these oxide ions increases exponentially with the temperature and reaches a sufficiently high temperature above 600°C.

The gas to be measured passes through the ceramic oxide ion conductor, which is a gas-tight tube. The ceramic tube is situated axially symmetrically in a thermally well-insulated heater. The electrodes of the galvanic sensor are made from platinum. The electrode on the outside of the tube, surrounded by dry air, is used as a reference electrode with a constant, known electrode potential. (composition see chapter 6.1.2)

Equation for oxygen concentr.

Based on the assumption that the total pressures of the gases are almost the same at both electrodes (in this case the volume concentrations may be used in the calculation instead of the partial pressures) and replacing the parameters by numbers in equation (**I**) the following equation applies:

$$\varphi_{O_2} = 20.64 \cdot e^{(-46{,}42 \cdot \frac{U}{T})} \quad \textbf{(II)}$$

φ_{O2} – oxygen concentration in the measuring gas in vol%

U – potential difference in mV

T – measuring temperature in K

20.64 – oxygen concentration in air with a relative humidity of 50% in vol%

4.2 General recommendation

The oxygen may be in free or bound form inside the measuring gas[1]. (see chapter 10.1)

Thereby, the following dependencies are valid:

$U \sim T$ – for free oxygen

$U \sim \frac{1}{T}$ – for bound oxygen

The equation **(II)** for calculating the oxygen concentration is valid for measuring gases with free oxygen as well as for reducing gas compounds in which oxygen only exists in bound form (e.g. in H_2/H_2O- or CO/CO_2-compounds).

4.2.1 Gas flow rate

The constant flow rate of the measuring gas is ensured by an internal pump. It can be chosen between **HIGH** (35 l/h, maintenance interval runs 3 times faster than in the LOW mode) and **LOW** (8 l/h).

---

[1] Different conditions of oxygen in the measuring gas must be distinguished:

Free oxygen: Oxygen molecules in the gas are independent without a bond to other gas components (inert gases such as N_2 or Ar).

Bound oxygen: Free oxygen molecules do not exist in the gas, only in bound form e.g. as water vapor. Higher temperatures cause a dissociation and oxygen molecules are available. Since the dissociation degree increases with the temperature, the measurement result depends on the temperature.

Possibly, free oxygen can react with potential burnable gases at the hot platinum electrode. The result can be a reducing gas.

4.2.2 **Accuracy of the measurement**

The manufacturer guarantees a measuring error of less than 5 % (relative error) only with measurements of oxygen concentrations within a range of 2 · 10^5 ... 10 ppm. For measurements of oxygen concentrations of 10 ... 10^{-3} ppm, the relative error is less than 5 % if the gas inlet tube has no leaks or permeability.

For measurements of oxygen concentrations less than 10 ppm, the following aspects must be taken into account during evaluation:

- composition of the measuring gas (e.g. presence of burning gases)
- specific characteristics of the production process (e.g. material used)
- temperature of the measuring gas.

NOTE

To reduce the measuring error in low oxygen concentrations, the following conditions must be provided:

- The measuring gas must be extracted where a formation of layers can be avoided.
- The tube from the measuring point to the SGM7.2.4 must be as short as possible in order to avoid a change in the chemical balance in the tube.
- All gas inlet and outlet tubes must be free of leaks.
- If the measuring gas contains reducing components (e.g. alcohol), the concentration of free oxygen cannot be determined correctly as chemical reactions occur at the electrode. In such cases, the measuring gas should be filtered by an activated carbon filter before entering the SGM7.2.4 (see chapter 10.1).

4.2.3 **Special features (operating hours counter and maintenance interval)**

Open the menu 'OPERATING HOURS' by pressing any key.

```
TOTAL TIME:      1234 h
CHANGE CARBON
FILTER IN:          0 h
MAINT.INTERVAL:   600 h
RESET
USER CODE
RETURN
```

First, enter the password, then set the time of the preset maintenance interval to the next filter change (choose line 'RESET' and press 'Enter').

In pump mode HIGH the maintenance interval runs 3 times faster than in mode LOW!

5 Technical data

5.1 Characteristics

Description	Protective gas monitor SGM7.2.4
Application	Measuring of the oxygen concentration in inert gases
Measuring range	10 vol-ppm…20.6 vol% O_2
Accuracy at normal pressure	Relative measuring error < 5 %
Measuring gas flow rate	8 resp. 35 l/h (low, high)
Max. permitted pressure of the gas	20 mbar over pressure
Max. permitted temp. of the gas	80 °C
Δp over measuring cell	Approx. 1 kPa (100 mm WS) at 10 l/h
Working conditions	10…45 °C, rH < 80 % at 20 °C
Storage conditions	-20…60 °C, rH < 95 % at 20 °C
Degree of protection	IP40

5.2 Mechanical data

Dimensions	135 x 100 x 240 mm
Weight	3 kg
Gas input	Plug connection 6 mm
Gas output	Tube nipple 4 mm

5.3 Electrical engineering/electronics

5.3.1 General data

Current supply

Voltage	100…240 V AC, 47…63 Hz
Current consumption	35 VA
Heater measuring cell	24 V DC, approx. 10 W (controlled internally)

Keypad and display

Keypad	3 keys
Text display	LCD dot-matrix

5.4 Interface data

Serial interface RS-232

Transfer rate..... max. 19200 Baud, adjustable
Stop bits 1
Data bits 8
Parity ..... none
Handshake ..... without

Pin-configuration connector SUB-D 9-pol. F:

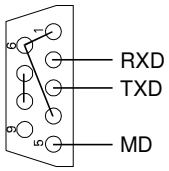


Chart 1: *Serial interface protocol (CR = Carriage Return)*

Command	Response	Description
M2CR	M2x.xxExxCR	Oxygen concentration in ppm
A1CR	A1xxxCR	Cell voltage in mV
A2CR	A2xxxCR	Measuring cell temperature in °C

Chart 2: *Error indication*

	Error code	Description
0	ERROR0	Transmission error
1	ERROR1	Warm-up
2	ERROR2	Cell temperature too low
3	ERROR3	Thermocouple defective
4	ERROR4	Operation hour meter run out! Change filter or carbon, then reset! (see manual)
5		
6	ERROR6	System error

Analog output

SGM7.2.4: Voltage output, 0/2 - 10V, potential-free, range adjustable

SGM7.2.6: Current output, 0/4 – 20 mA, potential-free, range adjustable

Chart 3: *Limit value relay*

Charge	Resistive charge (cosφ = 1)
Max. switching voltage	125 V AC, 60 V DC
Max. switching current	1A
Max. switching power	62.5 VA, 30 W
Min. permissible charge	1 mA at 5 V DC

5.4.1 Pump control

A powerful pump is integrated in the SGM7.2.4, which can be controlled via interface RS232:

Chart 4: *pump control via RS232*

Command from PC	Reply of SGM7.2.4	Remark
P0CR	P0CR	pump off
P1CR	P1CR	pump low
P2CR	P2CR	pump high
pCR	p**X**CR	*scan pump state* X=0 pump off X=1 pump low X=2 pump high

Control input for pump relay: 24 V DC (internal inverse-polarity protection and free-wheeling diode)

Chart 5: *Pin config. for 7-pol. socket and connection cable with plug (1.5 m long)*

Pin	Description	Cable color
1	limit relay NC contact	blue
2	limit relay NO contact	brown
3	limit relay central contact	green
4	pump control	white
5	pump control	grey
6	output +	pink
7	output -	yellow

6 Composition of the oxygen monitor SGM7.2.4

6.1 General composition

6.1.1 General overview

The SGM7.2.4 is a portable device. The general composition is shown in Fig. 1.

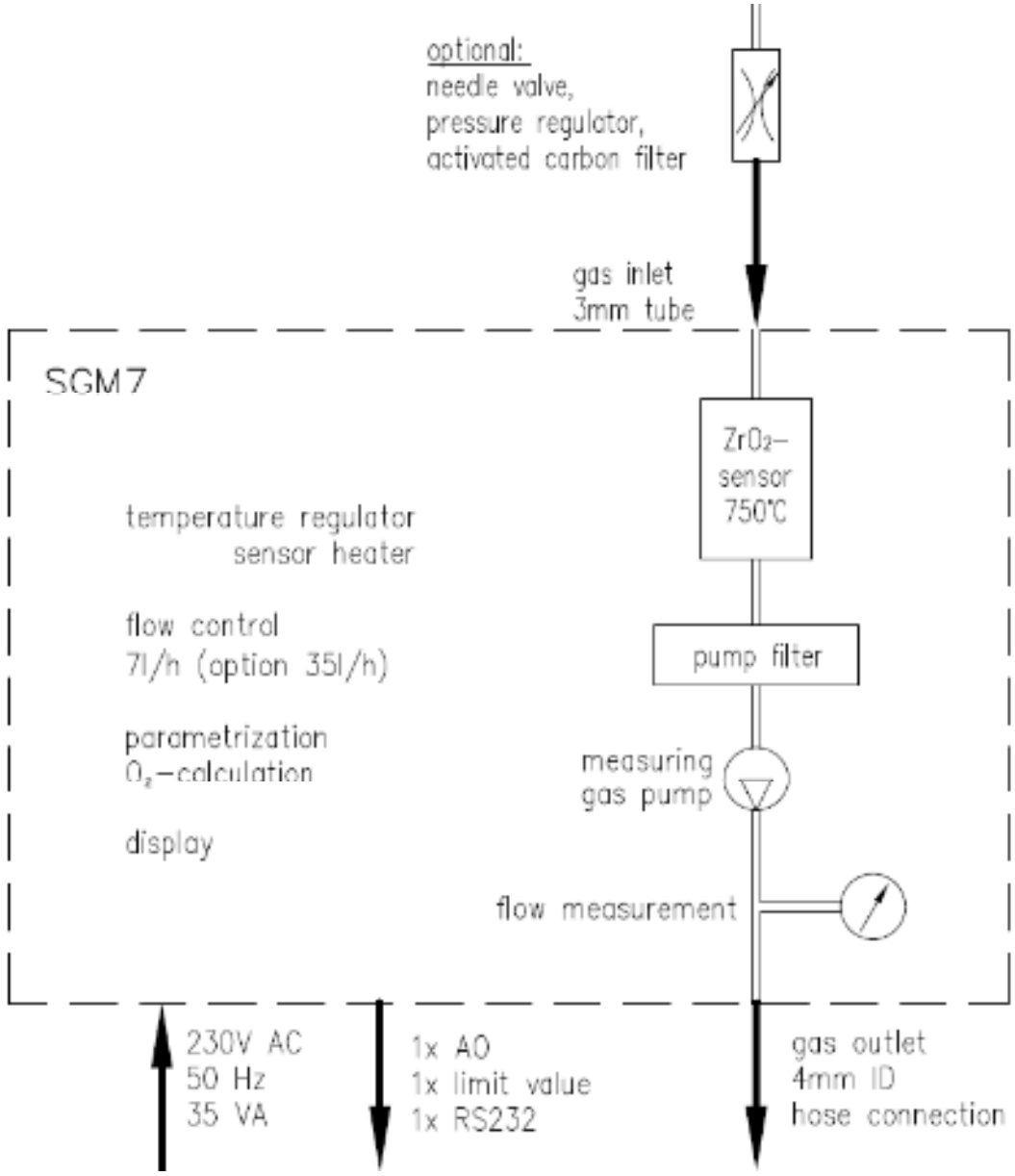
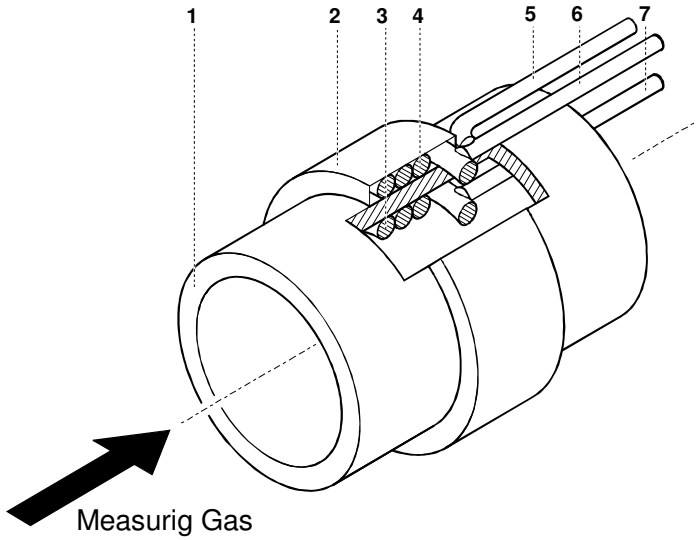


Fig. 1: *General composition of the SGM7.2.4*

The measuring gas gets into the sensor by means of little overpressure at the inlet or the optional pump ingests the measuring gas. In the first case, the optional pressure reducer or needle valve at the gas inlet can be used to control the gas flow. If the pump is installed, the gas flow is controlled by a flow control of the pump.

6.1.2 **Construction principle of the solid electrolyte sensor**



1 Ceramic tube
2 Ceramic cover of reference electrode
3 Measuring electrode
4 Reference electrode
5 Thermocouple
6 Connecting wire of reference electrode
7 Connecting wire of measuring electrode

Fig. 2: *Composition of the solid electrolyte sensor*

Measuring cell (sensor)

The measuring cell (sensor) consists of a tube made of zirconium dioxide (2/1) with two platinum electrodes. The measuring electrode is inside the tube (2/3). The reference electrode (2/4) is located on the outside of the tube and has a constant electrode potential. The electrodes and the ceramic tube form a galvanic solid electrolyte measuring cell.

Sensor heater

In order to gain a higher oxide ion conductivity of the zirconium dioxide tube, the sensor is heated to 750°C. This also avoids interfering reactions with combustible components of the measuring gas at the electrode caused by chemical unbalances. A thermocouple (2/5) inside the measuring cell determines the actual electrode temperature. A regulator ensures a constant temperature.

The heated measuring cell produces thermal energy. Therefore, the SGM7.2.4 must not be covered.

6.1.3 **Electronic data processing**

The following block diagram illustrates the data processing.

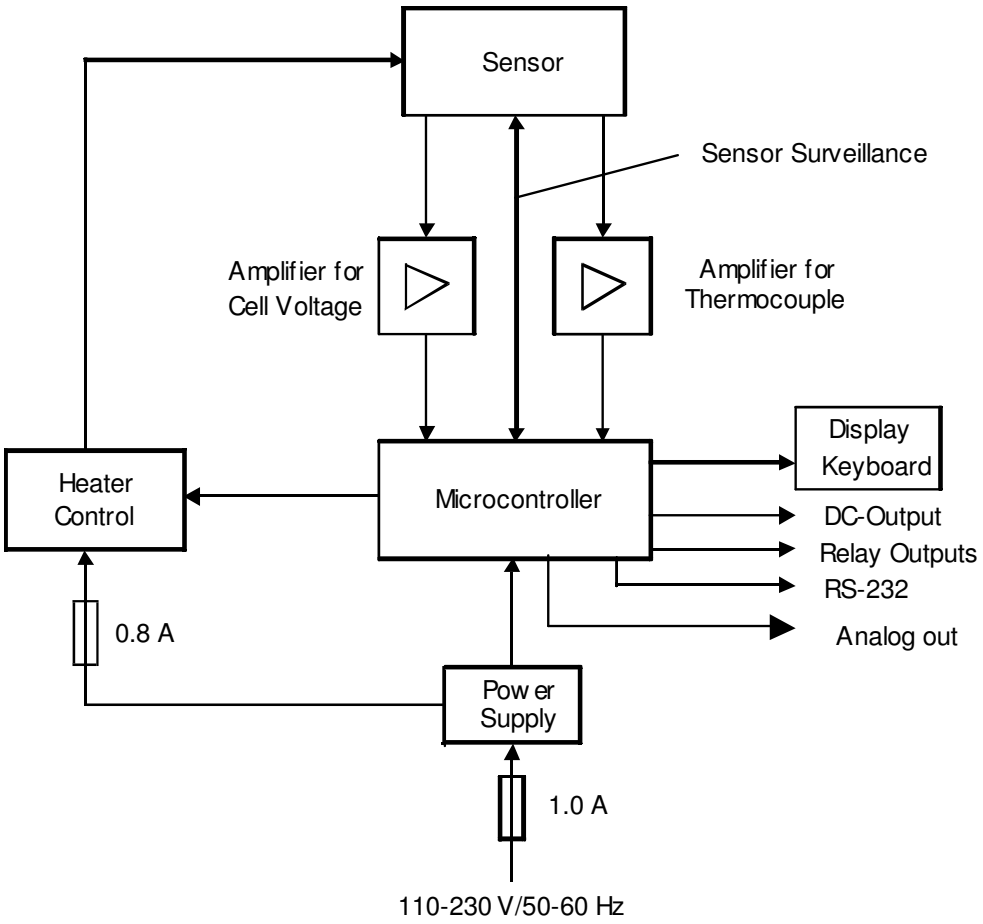


Fig. 3: *Block diagram of the SGM7.2.4*

6.2 Usage and connection elements

6.2.1 Current supply

The SGM7.2.4 is firmly connected to the current supply by a connecting cable.

6.2.2 Front

The indicators and control elements are located on the front of the SGM7.2.4. Depending on the size, the measuring values are displayed either in vol% or in vol-ppm.

A green or orange light serves as operating indication depending on the chosen limit value and actual measuring value. A red light points out certain operating or warning conditions (see chap. 8.1.4).

A keypad is located on the right side of the front panel. It serves the programming of the device.

Fig. 4: *Front of the SGM7.2.4*

6.2.3 **Rear**

The gas inlet and outlet, the analog output and limit value relay (connection for pump control relay included), the RS232-Interface, the pump switch and the power switch are located on the rear panel.

The gas inlet is connected with the carbon filter. The inlet of the filter is located on the front side.

The line cord is permanently fixed with the device. It cannot be connected.

Fig. 5: *Rear of the SGM7.2.4*

7 Installation and initiation

7.1 Installation conditions

NOTE

The protective gas monitor must be set up in a dry and mainly dust-free place on a stable, flat surface.

- A socket, preferably as a separate electrical circuit, must be available in immediate proximity of the installation place, protected with a 10 A fuse.
- No heat sources or appliances, which produce strong magnetic fields (e.g. electric motors, transformers), should be put in the proximity of the installation place.
- The SGM7.2.4 operates in horizontal position.

A vertical placement may cause damage by heat accumulation and is not permitted.

A liquid entry can lead to severe damage or to the complete destruction of the device.

7.2 Set-up of operating state

NOTE

A temperature compensation is required after the transportation of the SGM7.2.4 from cold surroundings to a site with higher ambient temperature or humidity**.** A **waiting time of about 2 hours** before switching-on must be considered.

1. Install the SGM7.2.4 in the favored place (see chapter 7.1).
2. Connect point of measurement and places of gas inlet and outlet of the SGM7.2.4. Pay attention to leak-tightness.
3. If a pressure limit is required, install a needle valve directly in front of the gas inlet (available from manufacturer of the SGM7.2.4).
4. If the amount of water vapor in the measuring gas is likely to cause a condensation of water in a cold gas pipe, a water trap must be installed in front of the gas inlet. (The penetration of water into the hot measuring cell can destroy it and therefore must be absolutely prevented.)
5. Connect the SGM7.2.4 to the power supply.

Material of the connecting tubes

On long transport routes and at unfavorable temperatures the material of the connecting tubes must rule out any oxygen permeability. The manufacturer recommends the following materials in dependence on the measuring conditions:

Low temperature of measuring gas	Thick-wall PVC-hose
Higher temperature of measuring gas	Tygon R 3603 (supplier e.g. Novodirekt Kehl)
Oxygen concentration of < 100 ppm	Stainless steel tube.

Silicone can cause measuring inaccuracies because of its oxygen permeability. Therefore, the manufacturer advises against a usage.

NOTE

The measuring gas can also flow through the SGM7.2.4 when it is off.

8 Operation and parametrization

8.1 Operation

8.1.1 Switch-on and measurement indication

When the oxygen monitor is in operating state and all lines are connected according to chapter 7.2, the SGM7.2.4 can be switched on. The measuring cell reaches its operating temperature of 750 °C after approx. 10 minutes. The current measuring value is displayed but only reaches the indicated error limits after an hour when the thermal conditions in the measuring cell are even.

After switch-on, the SGM7.2.4 is in display mode. On the display the programmed measuring value for output 1 is shown (normally the oxygen concentration) according to the chosen dimension.

8.1.2 Gas flow adjustment

Two different flows can be adjusted via display (low 8 l/h, high 35 l/h)

NOTE

For excess pressure of the measuring gas, the manufacturer recommends the installation of a high-quality needle valve. Appropriate needle valves can be delivered by the manufacturer of the SGM7.2.4. For higher pressures of the measuring gas, an **additional** pressure regulator is recommended which adjusts a pressure of approx. 100 kPa (1 bar) **excess pressure**.

8.1.3 Data monitoring

The SGM7.2.4 can be programmed with a limit value. The relevant messages are delivered via relay output. The relay is open in active state (This state is displayed in the status line). The signalization is delayed. The response time can be adjusted for the data monitoring (limit value delay time) between 1 and 99 seconds.

8.1.4 Indication of the end of maintenance interval for carbon filter

Before operation, the maintenance interval must be set for an optimum value in the respective process. 600 hours are preset but on the basis of experience, a considerably shorter operating time of the filter might be expected.

Changes and reset of the maintenance interval are password-protected (only possible via display).

The password in the delivery status is **1234**.

8.1.5 Status and error messages

Self-check of the SGM7.2.4

During the measuring, the functions of the measuring cell are monitored. In case of faults and/or errors, messages are displayed. The relay output is activated simultaneously.

Chart 6: *Status / error messages*

Status	Display	Remark
0	OK	
1	LIMIT	
2	RANGE <<<	**No alarm (only SGM7.2.4)!** *Several reasons – see chapter 8.4*
3	RANGE >>>	
4	FLOW <<<	< 8 l/h
5	FLOW >>>	> 35 l/h
6	Change filter!	> 600 h (or after period adjusted by customer)
7		
8		
9	WARM-UP	Cell temperature too low (wait, after approx. 15 minutes 750 °C are reached)
10	CELL TEMP.<<<	Set temp. -10° and > 30 min
11	ERROR THERMOCOP.	Thermocouple broken
12		
13		
14	SELF-TEST FAILED	

SGM7.2.4

Status 1, 4...8: warnings, only alarm relay active
Status 2, 3: warnings, **no alarm** by alarm relay
Status 9...14: failure, alarm relay active **and** analog output (voltage signal) **10 V**

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Status 1...8: warnings, only alarm relay active
Status 9...14: failure, alarm relay active **and** analog output (current signal) **0 mA**

8.2 Parametrization

8.2.1 Adjustable parameters

Chart 7: *Overview of the adjustable parameters*

Parameter	Range	Remarks
Display	O_2: 0…21 vol% or in ppm	Range up to 100 vol% on request
Analog output	0-10 V or 2-10 V **(SGM7.2.4)** 0...20 mA or 4...20 mA **(SGM7.2.6)**	
Scale of output	Linear Logarithmic (Basis 10)	Logarithmic scale recommended if measuring value exceeds several decades.
Suppressed zero point	0.00001…21 vol% or 0.1…210000 ppm	For optimal resolution at a special range
Max. measuring value	21.0 vol% or 210000 ppm, Higher values on request	This value corresponds to the terminal value of the analog signal (e.g. 10 V)
Response time t_{90}	1 ... 99 sec	Formed by arithmetical average of the measured value
Limit value	0…99.99 vol% or 0…999999 ppm	Selectable as lower or upper limit value with the signs”>” or ”<”
Delay time of the limit value	1 ... 99 sec	Time to alarm when limit value is exceeded
Transmission capacity of RS-232-interface	4800, 9600, 19200 Baud	
Internal measuring gas pump	Switch on/off by soft key, switch at the rear side or RS232 High/Low via keypad or external controlling (RS232) adjustable	
Maintenance interval	0…999 h	Count down, at zero alarm indication for filter change

8.2.2 Programming menus

The keys below the display refer to the following menus (the current meaning of the respective key is shown on the display). A definite parameter can be chosen, changed and finally confirmed with the ↵ -key.

A Main display

OXYGEN: **20.64vol%** **WARM UP** **PUMP OFF 750°C**	*Status line* *Pump status (on/off by key) and cell temperature*

The following status can be visualised by LED:

red flashing: **Error**

green: **OK**

yellow: **Limit value**

(constantly – pump off, slow flashing – pump low, fast flashing – pump high)

B Settings

SETTINGS
OPERATING HOURS
GENERAL
LIMIT
ANALOG OUTPUT
CALIBRATION
RETURN

B.1 Operating hours

TOTAL TIME: 90 h	*Total operating hours of the device*
CARBON FILTER	
CHANGE IN: 145 h	*Time remaining to filter change*
MAINT.INTERVAL: 600 h	*Filter change after 600 h, adjustable*
RESET	*Reset maintenance interval*
USER CODE	*Delivery status: 1234*
RETURN	

B.2 General settings

GENERAL SETTINGS		
LANGUAGE:	**ENGLISH**	*English, Deutsch*
BAUD RATE:	**9600**	*4800,9600,19200*
CONTRAST:	**0**	*+- 9*
BEEP:	**ON**	*OFF*
RETURN		

B.3 Limit values

LIMIT VALUE		
VALUE:	**> 206400 ppm**	*0…999999 ppm resp. 0…99,99 vol%*
DELAY TIME:	**1sec**	*0...99sec*
RETURN		

B.4 Output

ANALOG OUTPUT		
VALUE:	**ppm O2**	*vol% O2, O2[log10]*
RANGE:	**0-10 V**	*2-10V(**SGM7.2.4**), 0-20 or 4-20 mA (**SGM7.2.6**)*
ZERO POINT:	**0 ppm**	
END MARK:	**210000 ppm**	
AVERAGE FACTOR:	**1sec**	*1-99sec*
RETURN		

B.5 Calibration

CALIBRATION
CALIBR. ZERO POINT
CALIBR. SPAN GAS
RETURN

B.5.1 Calibration zero point

CALIBR. ZERO POINT	
MEAS. VALUE: 206400 ppm	*Current measuring value*
ZERO GAS: 206400 ppm	*ZERO GAS always 20.64 % (surrounding air)*
CALIBR: ZERO: WAIT 5	*Status*
CALIBR. VALUE: - 4.5	*Calibration value *1*
RETURN	

*1 If this line is activated and key **Ente**r is pressed for approx. 3 sec, the calibration value will be set to 0.0!

B.5.2 Span gas calibration

CALIBR. SPAN GAS	
MEAS. VALUE: 206400 ppm	*Current measuring value*
SPAN GAS: 1000 ppm	*Adjustable*
CALIBR. SPAN: WAIT 5	*Calibration status*
CALIBR. VALUE: 1.00	*Calibration value *2*
RETURN	

*2 If this line is activated and key **Ente**r is pressed for approx. 3 sec, the calibration value will be set to 1.0!

B.5.3 Saving

SAVE VALUES ?

YES

NO

8.3 Calibration

For measurements with high accuracy requirements a calibration is highly recommended (The high stability of the measuring cell requires one check-up per a year only!).

The device must be in operating state for a minimum of one hour before the calibration!

8.3.1 Zero calibration

The zero calibration serves the balance of the offset voltage of the ZrO2-sensor. The offset is caused by the construction (when the electrode has a disadvantageous position in the heating field) and can occur due to aging of the sensor.

Before calibration, the sensor is flushed with ambient air. The gas flow is set by internal or external pump at the value, which is used for measuring the measuring gas.

With the zero calibration, the working point in ambient air is calibrated with 20.64 vol.% O2.

First, select “Calibration” and then “Calibration ZERO POINT” via keypad. Select “CALIBR. ZERO:” and start the calibration by pressing “ENTER”. After approx. 5 sec the calibration is finished. Leave the calibration by pressing „RETURN“ and „ENTER“. Save it with „YES“.

8.3.2 Span gas calibration

Certified test gas (oxygen concentration near future measuring conditions) must flow through the device.

First, select “Calibration” and then “CALIBR. SPAN GAS” via keypad. Set the test gas oxygen concentration. Select “CALIBR. SPAN:” and start the calibration by pressing “ENTER”.

The stability of the measuring value is checked during the calibration. The real calibration process starts as soon as the signal produced by the span gas is stable. Therefore, the duration of the calibration process can vary (variation smaller than 1 % in 4 seconds).

If the stability is not given, the calibration is stopped after 60 seconds.

Furthermore, the deviation of measuring value from set value is evaluated. At zero point calibration +/- 20 mV (cell voltage), at span gas calibration +/- 20 % of measuring value (cell voltage) are allowed.

For the adjustment the following equation applies: $Uc_{ell}(korr)=(Uc_{ell}+A)*B$

U_{zell} = measured cell voltage

A = cell voltage at zero point

B = factor for final value correction

The calibration is left by „RETURN“ and „ENTER“. The calibration is saved by „YES“.

8.3.3 Calibration status

Chart 8: *Messages calibration status*

OK (1.5)	last calibration OK (calibration value)
WAIT ! 5	calibration is running
BREAK	cancelled by pressing key
TIME OUT	stability not reached within 60sec
OUT OF RANGE	range exceeded
FAILED	instrumental error
START	start calibration

8.4 Fault clearance

Chart 9: *Disturbances - causes and clearance*

Disturbance	Cause	Clearance
Display off	SGM7.2.4 off	switch on SGM7.2.4
	No current supply	Check current supply and cord line
	Equipment fuse triggered	Change equipment fuse
Warning: FLOW <<< (Flow too low)	Gas supply blocked, too long for chosen cross section or leaky	Check gas supply Remove blockages Establish tightness
	Pump defective	Replacement by manufacturer
Change filter!	Maintenance interval zero	Change carbon filter, reset interval
Relatively high measuring value, although a low value for the oxygen concentration is expected	Gas flow too low	Increase flow rate
	Micro leaks in the gas supply	Check fittings
Measurement is dependent on the throughput (the smaller the flow, the higher the value or vice versa)	Leaks in the measuring gas supply	Check gas supply and fittings
Measuring value is significantly lower than expected	Reacting components (at high temperatures with oxygen) in the measuring gas (e.g. hydrocarbons)	Check activated carbon filter for saturation
Warning: “WARM-UP”	Measuring cell has not reached operating temperature yet	Wait for 5 minutes Check current temperature on display
	Fuse for sensor heater triggered	Switch off, check after switching on if fault appears again – in this case consult service
	Heater or regulator defective	Consult service
Warning: ERROR THERMOCOP.	Thermocouple defective	Consult service
Warning: SELF TEST FAILED (system error)	Error program- or data memory	Consult service

9 Maintenance, overhaul and storage

9.1 General instructions

The electronics and the measuring cell are maintenance-free.

In case of defects in measuring cell or thermocouple, send the SGM to the manufacturer for an overhaul.

storage

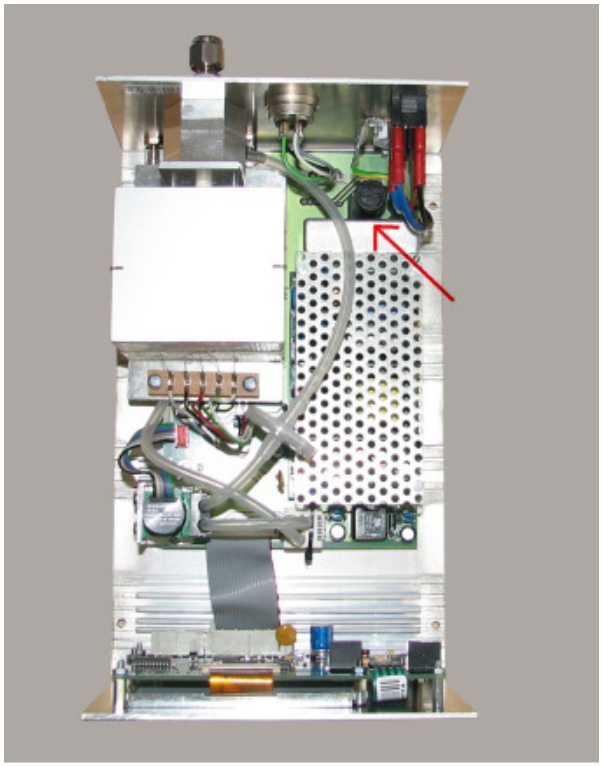
If not in use, the SGM has to be stored in the original packing (if possible) in a **dry, dust-free room**.

9.2 Replacement of the equipment fuse

Turn the SGM off and separate it from the net supply before replacing the equipment fuse.

danger

The fuse (1 AT) is located inside the device (see arrow). It has to be replaced by the same type.

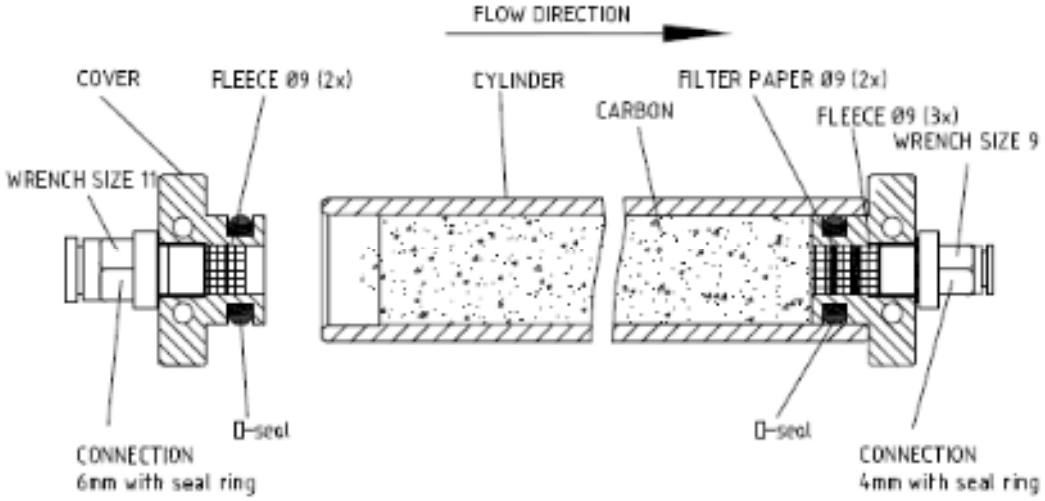


After switch-off the housing of the measuring cell keeps a temperature of approx. 60 °C for a while.

ATTENTION

10 Appendix

10.1 Activated carbon filter: description and application notes



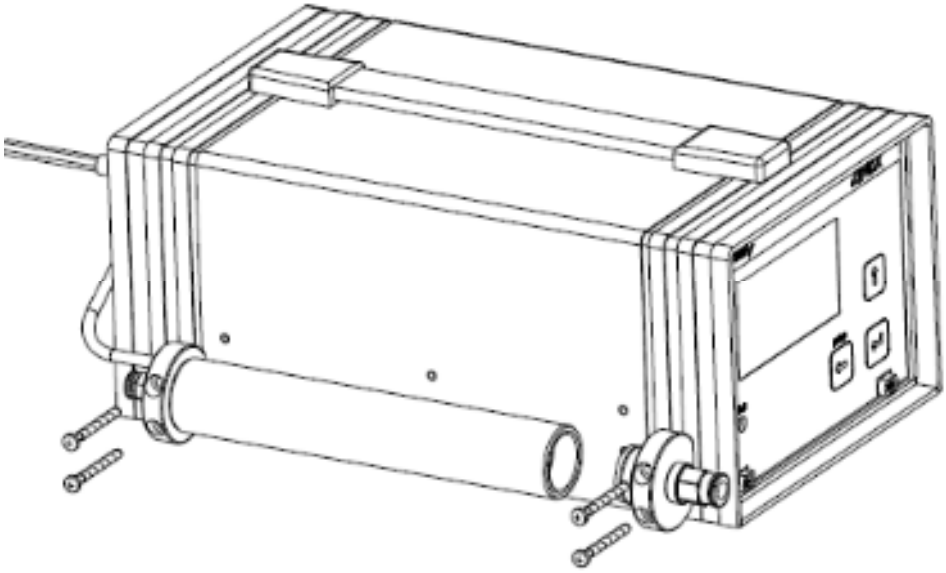
10.1.1 Filter construction

The figure above shows the carbon filter. Two caps with tube connections close the acryl glass container containing the activated carbon. Both caps are inserted into the tube (sealed by O-seal). The fittings (tube connection with seal ring) have closing stoppers to keep the carbon inside. The gas way is protected against carbon particles with a pre-filter and a fine filter (2 filter paper discs) in the outlet of the carbon filter.

10.1.2 Application and operation of the filter

Organic components of the test gas (e.g. alcohols) are adsorbed by the carbon. After longer usage the cell voltage or the oxygen concentration can drop unexpectedly. This is a sign for saturation of the filter. The filter or the carbon filling must be replaced (see 10.1.3).

10.1.3 **Replacement of activated carbon**



Please follow the instructions for replacing the activated carbon.

1) Separate gas connections of the filter at gas inlet and outlet
2) Loosen all four M3-screws which connect filter and housing
3) Remove cover on the inlet side from acryl glass tube by twisting it slightly
4) Dispose of spent carbon
5) Remove cover on the outlet side by twisting it slightly
6) Remove paper filter and fleece from connections in the caps with tweezers
7) Insert 2 fleece discs with tweezers into the tube connections on the gas inlet side
8) Insert 3 fleece and 2 filter paper discs on the gas outlet side (fleece-paper-fleece-paper-fleece)
9) Insert cover (gas outlet) into acryl glass tube by twisting it slightly
10) Refill the container with new activated carbon (use funnel) and compress it by knocking a piece of wood; screwdriver or the like gently on the housing
11) Fill in the carbon but leave a gap of 1-2 mm to the second cap
12) Attach assembled acryl filter with the M3-screws to the housing
13) Connect gas outlet of the filter with gas inlet of the measuring device

Make sure to insert the fleece discs!

Do not remove the closing stopper in the Swagelok fittings!

10.1.4 **Technical data**

Weight	Approx. 120 g
Volume	Approx. 100 ml
Duration of operation	Depending on the components and the concentration of the adsorbed organic components e.g. approx. 1…3 months at raw gas from a fermenting tank (ZKG)
Carbon used	Granulated or pelletized, 1…3mm

10.2 EU Declaration of conformity

EG - Konformitätserklärung

Dokument- Nr.: **15** **16. Mai 2006**

Hersteller: **Zirox Sensoren & Elektronik GmbH**

Anschrift: **Am Koppelberg 21**
D - 17489 Greifswald

Produktbezeichnung: SGM 7

Die Übereinstimmung des bezeichneten Produktes mit den Vorschriften der Richtlinie des Rates
89/336/EWG (zuletzt geändert: 93/68/EWG)
wird nachgewiesen durch:

Der Hersteller hat die in der Richtlinie 89/336/EWG genannten harmonisierten Normen angewandt und die Übereinstimmung des Produktes festgestellt.

harmonisierte europäische Normen:

Nummer:	Text:	Ausgabedatum:
DIN EN 61000-6-2	Elektromagnetische Verträglichkeit (EMV) Teil 6-2: Fachgrundnorm: Störfestigkeit für Industriebereich	08.2002
DIN EN 61000-6-3	leitungsgeführte Störaussendung Gestrahlte Störaussendung	08.2002
DIN EN 50270	Elektromagnetische Verträglichkeit (EMV) Elektrische Geräte für die Detektion und Messung von brennbaren Gasen, toxischen Gasen oder Sauerstoff	01.2000

Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, beinhaltet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

Aussteller: **Zirox Sensoren & Elektronik GmbH**

Ort, Datum: Greifswald 18.5.2006

Rechtsverbindliche Unterschrift: .....

ZIROX
Sensoren & Elektronik GmbH
Am Koppelberg 21
17489 Greifswald

10.3 Warranty conditions

ZIROX Sensoren & Elektronik GmbH warrants that the products manufactured and sold are free from manufacturing and material defects at the time of dispatch. In case of defects and faults within 12 months (probe) and 24 months (electronics assembly) respectively after dispatch, ZIROX will clear faults at its own option by repair or replacement. The purchaser must give prompt written notice to ZIROX. The purchaser is not entitled to claim other legal remedies based on this warranty.

ZIROX does not warrant supplied products which are subject to normal wear and tear (e.g. reference gas pump).

Corrosive gases and solid particles may cause damage and require repair or replacement due to normal wear and tear.

The contact of the products with explosive gas compounds, halogens in high concentrations and sulphuric gases (e.g. SO_2) is not permitted.

The contact of the products with siliconic or phosphoric compounds is not permitted either.

A connection of ZIROX and non-ZIROX products voids any warranty claims.

Warranty and warranty claims are only accepted if they are in accordance with the "General Sales and Delivery Conditions" of the manufacturer.

Warranty and liability claims for damage to persons and/or property are void if they are subject to the following:

- Normal wear and tear
- Improper use of the product
- Disregard of the manual’s instructions
- Improper installation, initiation, operation and maintenance of the product
- Operation of the product without protective measures
- Unauthorized functional and technical modification of the product
- Dismantling of parts as well as installation of spare parts or additional units, which are not delivered or permitted by the manufacturer
- Improper repairs or faulty operation
- External impact
- Acts of God

Attention: When installing the equipment, the customer must ensure that all necessary supply lines are connected and the operating temperature of the probe is reached. Experience has shown that products installed but not in use may be damaged by the process or by external influence. ZIROX will not accept any responsibility for such damage.

11 Your own notes and remarks