



Operating Instructions

Oxygen Measuring System

for Composting

- Read before use!
- Observe all safety instructions!
- Keep for future reference!



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1. For your safety

Observe the instructions for use

Any person handling or operating the oxygen measuring system must first be fully familiar with and observe these instructions for use. The oxygen measuring system is to be used only for the described purpose (see section 1.2).

Servicing

The oxygen measuring system must be inspected and serviced regularly by qualified specialists. Repairs to the oxygen measuring system must only be carried out by qualified specialists. (See sections 1.4 and 5.)

Do not operate in areas subject to explosion hazards

The oxygen measuring system is not approved for operation in areas subject to explosion hazards. Do not operate it in any areas where combustible or explosive gas mixtures are likely to occur.

WARNING!



These operating instructions do not contain all the information necessary for the safe operation of the device. Please acquaint yourself with the regulations and operator's obligations that apply in your area. In addition to these operating instructions, for example, you should observe and instruct others concerning the universally valid legal and other binding regulations for the prevention of accidents and protection against accidents.

1.1 Safety information and tips

A series of warnings is used in these instructions concerning some of the risks and dangers that may occur when using the oxygen measuring system. These warnings contain "signal words" designed to draw attention to the degree of danger that is to be expected.

These signal words and the associated hazards are as follows:

	<p><u>DANGER!</u> Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.</p>
	<p><u>WARNING!</u> Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</p>
	<p><u>CAUTION!</u> Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.</p>
	<p><u>IMPORTANT!</u> Indicates information concerning use and other useful information.</p>



1.2 Intended use

The oxygen measuring system is designed for measuring the oxygen concentration in compost heaps.

The oxygen measuring system must be used exclusively for:

- Determining the concentration of the oxygen content in air/solid mixtures (maximum mix temperature +100° C)
- Measuring the oxygen concentration in air and inert gas mixtures (N₂, CO₂, noble gases)

The oxygen measuring system is **not** suitable for determining the oxygen concentration in liquids.

It is essential that the oxygen measuring system is installed only as described in section 3.3 and that the ambient conditions specified there (e.g. temperature limits) are adhered to!



WARNING!

Danger of fire and explosion due to sparks!

The oxygen measuring system may not be operated in areas where ignitable or explosive gas mixtures can arise.



IMPORTANT!

The oxygen measuring system must only be opened and repaired by the manufacturer. Do not modify the oxygen measuring system and do not reconstruct it. Otherwise the oxygen measuring system might no longer measure the oxygen concentration reliably.



IMPORTANT!

The sensor in the oxygen measuring system contains zirconium dioxide and platinum and can be destroyed by the catalyst poisons listed in section 9.2. These substances must therefore **not** be contained in the gas mixture that is to be measured!



IMPORTANT!

The measuring signals from the oxygen measuring system must be evaluated and further processed by the user's downstream device.



IMPORTANT!

It is essential to observe the information given in these operating instructions with regard to operation, maintenance and servicing.

Faults must be rectified immediately.

1.3 Other dangers

Despite its careful design, there remain some further dangers associated with handling the oxygen measuring system. The following are known to us:



DANGER!

Mains voltage (230 V, 50 Hz).

Danger to life due to electric shock or burns.

Do not bring into contact with water.

The housing must only be opened by the manufacturer.

Electrical work should only be carried out by a qualified electrician.

Only install in a voltage-free state.



WARNING!

The probe protection tube is very sharp.

Risk of injury!

Wear protective gloves.

Always store the device such that the tip cannot cause injury.

Never use the device as a weapon and never throw it. You might spear someone and kill them.



CAUTION!

The bar probe in the probe protection tube becomes hot (200° C).

There is a danger of fire and burn injuries if the probe protection tube is damaged!

Wear protective gloves.

Remove the device from service immediately if the probe protection tube is damaged.



1.4 Qualification of personnel

Only qualified mechatronic engineers or persons with comparable training may mount, install or commission the oxygen measuring system or carry out maintenance and servicing work.

Only qualified electricians may carry out work on the electrical system. (In Germany: according to German VDE!)

The operator must instruct all users of the system on the basis of these operating instructions.

The minimum age is 16 years. An experienced person must supervise juveniles and apprentices when working on the oxygen measuring system.

Any work that is not described in these operating instructions must be executed by the manufacturer.

2. Product description

2.1 Design of the oxygen measuring system

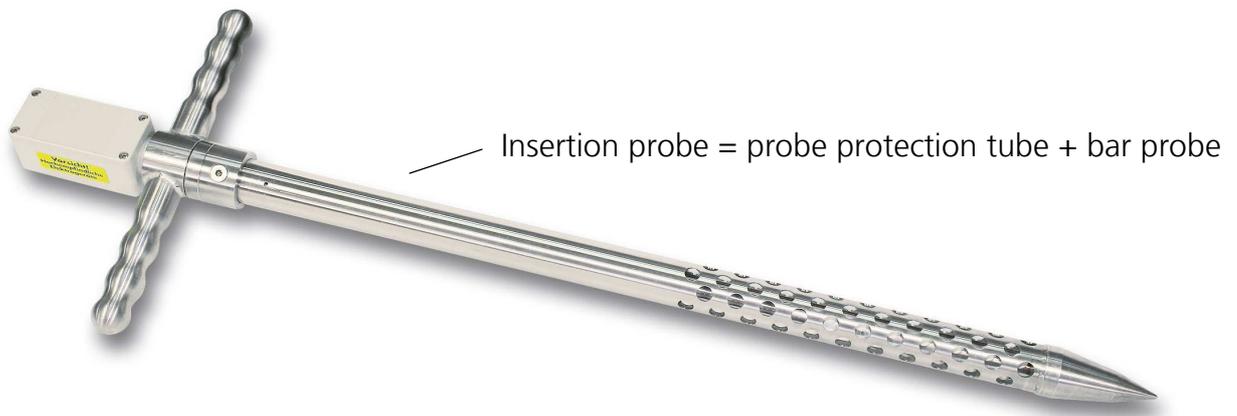


Fig. 1: Oxygen measuring system

The oxygen measuring system (see Fig. 1) has been specially developed for use in composting plants. The materials used are suitable for the difficult requirements posed by such an environment: the bar probe, probe protection tube and handles are made of stainless steel. The transmitter is accommodated in a grey macrolon housing. The housing and its cover are connected by means of a sealing ring and four stainless steel screws. Screw locking paint prevents unauthorised opening of the housing.

The bar probe is tightly screwed to the housing. The probe protection tube is attached to a flange with three countersunk screws. Bar probe and transmitter are inserted through the flange into the probe protection tube via a PG screwed cable gland. Additionally, the connecting plug is located on the housing.



IMPORTANT!

The device must only be opened by the manufacturer!

> The transmitter contains (1) a signal amplifier, (2) a controller for the ion pump with an analog part, (3) a test part, (4) the internal monitoring logic component, (5) the power supply for the probe heating element as well as for the analog and digital parts, (6) the reset and (7) the voltage monitor as well as (8) a bidirectional digital output (channel K2 or pin 6) and (9) a 4-20 mA analog output (channel K1 or pin 5).

The output signals from the oxygen measuring system are read and further processed according to the customer's specifications in a downstream device.

2.2 Principle of operation

The oxygen measuring system measures the oxygen concentration directly in the gas mixture and consequently the oxygen partial pressure (absolute oxygen content!). The measuring process is based on dynamic reactions between two zirconium dioxide discs, which form an hermetically sealed chamber. The entire measuring range is linear. Since the measuring system monitors its own functioning during operation and reports any hardware and sensor malfunctions, it can be operated in fail-safe mode when required. A second oxygen sensor is not needed for this purpose! Calibration is

carried out without reference gas in atmospheric air. The measured values are output via an analog (4-20 mA) and a digital channel, with the latter also transmitting the fault messages.

2.3 Technical data

Transmitter		
Power supply	7-pole plug-in contact	Amphenol-Tuchel circular connector
	Voltage	24 V DC \pm 5%
	Current	Approx. 500 mA, observe switch-on current, approx. 4 x nominal current!
Connections	Pin 1	24 V DC \pm 5%
	Pin 2	0 V
	Pin 3	Not assigned
	Pin 4	Test
	Pin 5 Analog output; channel K1	4-20 mA
	Pin 6 Digital output; channel K2	Pulse and fault, external calibration
	Pin 7	Functional ground
Ambient temp.	-10° C to +50° C	Sun can heat up the housing considerably!
Air pressure	900 hPa to 1100 hPa	
Output	4-20 mA	Max. load 500 Ω
Resolution	12 bit	
Housing	Makrolon8030 (30%GV), UL94V-1	Grey
Protection class of housing	IP 65	
Size housing	Approx. L105 x W60 x H42 mm	Width with handles: approx. 250 mm
Probe protection tube		
Length	Approx. 1,200 mm	
Diameter	Approx. 30 mm	
Material	Stainless steel 1.4301	
Total weight	Approx. 3,000 g	Transmitter + insertion probe
Ambient temp.	-10° C to +100° C	
Permissible humidity	15 to 95% relative humidity	Non-condensing

Sensor		
Warm-up time	Approx. 10 min	
Measuring range	0.1 - 25 vol% oxygen (oxygen partial pressure)	0.1 - 100 vol% oxygen upon request
Accuracy	± 2% of FS at 25° C	FS = Full scale
Reproducibility	± 1%	
Temperature	Up to +100° C	
Reaction time	Approx. 3 s	
Length	400 mm	
Diameter	12 mm	
Type of protection - sensor	IP 40	

i	<p><u>IMPORTANT!</u></p> <p>All equivalences of oxygen concentration and output signal (mA or length low phase) stated in this text refer to the standard measuring range of 0.1 to 25 vol% oxygen (refer in particular to sections 3.4 to 5). For a measuring range of 0.1 to 100 vol% oxygen, please refer to the details in the supplement.</p>
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2.4 Certification

The oxygen measuring system complies with EMC Directives EN 61000-6-2 and EN 61000-6-3 and thus Directives 89/336/EEC and 92/31/EEC.

3. Transport and installation

3.1 Transport

The oxygen measuring system is supplied together with these operating instructions. Please check the packaging for any damage when the product is delivered and report any damage immediately to the forwarding agency and dealer. The oxygen measuring system should not be thrown or dropped as it could be damaged or scratched. Protect against wet conditions, humidity, dirt and dust.

3.2 Storage

The oxygen measuring system may be stored in its packaging in dry rooms at temperatures between +10° C and +50° C. Protect it against wet conditions, humidity, dirt and dust.

	<p><u>IMPORTANT!</u> Materials containing silicone must not be stored in the same room as the oxygen measuring system; materials containing heavy metals and/or saline materials must not be stored close to the system, as these substances may destroy the sensor (see section 9.2).</p>
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	<p><u>IMPORTANT!</u> The caps on the plug-in contacts must be securely closed.</p>
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3.3 Installation

 	<p><u>WARNING!</u> The probe protection tube is very sharp. Risk of injury! Wear protective gloves. Always store the device such that the tip cannot cause injury. Never use the device as a weapon and never throw it. You might spear someone and kill them.</p>
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Remove the oxygen measuring system from the packaging and check that the probe protection tube, the bar probe and the transmitter are securely in place; tighten the PG screwed cable gland if necessary.

The oxygen measuring system has to be inserted into the compost in such a way as to prevent any possible condensate flowing into the probe electronics. The insertion angle must therefore be between 90 and 45°. The maximum insertion depth is 105 cm.

The bar probe in the probe protection tube must not come into contact with water (splashwater, condensate)!

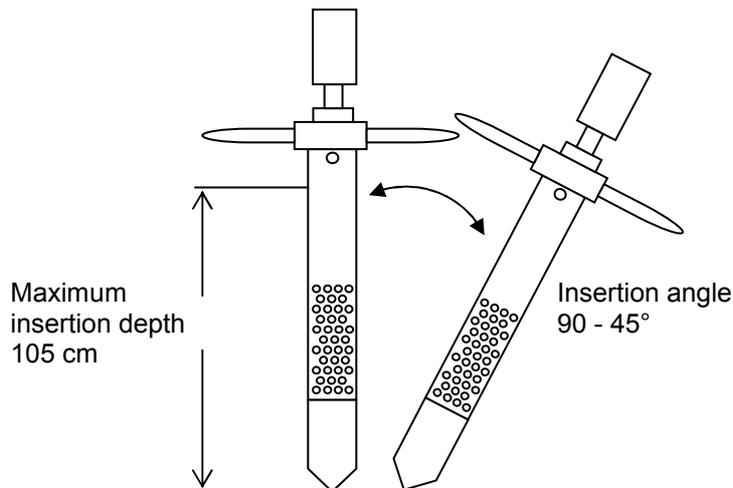


Fig. 2: Installation



IMPORTANT!

When installing, it is essential to remain within the following permissible ambient conditions:

Ambient temperature of housing between -10 and **+50° C** (please bear in mind that under certain circumstances the sun can heat up the housing considerably!).

Ambient temperature of insertion probe between -10 and **+100° C**.

The housing must be freely accessible and visible at all times.

The bar probe in the probe protection tube must not come into contact with water (splashwater, condensate)!

The bar probe must **not be accessible to dust** as this will block the diffusion opening and cause the oxygen measuring system to make erroneous measurements!

The ambient air must not contain **any of the harmful substances listed in section 9.2**, i.e. there must be no traces of heavy metals, silicones and so on as these will contaminate the oxygen sensor.

The oxygen measuring system must not be installed in damp locations or areas subject to explosion hazards.

Parasitic voltages must not be permitted to occur.



3.4 Electrical connection

	<p><u>DANGER!</u> Mains voltage (230 V, 50 Hz). Danger to life due to electric shock or burns. Do not bring into contact with water. The housing must only be opened by the manufacturer. Electrical work should only be carried out by a qualified electrician. Only install in a voltage-free state.</p>
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The measuring system and central unit must be connected with a permanent, microbe-proof, seven-core, shielded cable (diameter 9-11 mm) (see Fig. 3). Do not lay this line next to a high-tension power cable as there is a danger of radiated interference. The cable must be capable of withstanding the anticipated mechanical, chemical and thermal stresses. The power supply must be designed such as to guarantee the maximum switch-on current of 950 mA (when the oxygen measuring system is in a cold state).

For basic operation connect the oxygen measuring system to the electric circuit via Pin 1, Pin 2 and Pin 7 (see Fig. 3) and read the measured data via Pin 5 (4-20 mA) for example with the help of a measuring instrument, a display or a PLC (programmable logic controller).

For fail-safe operation, Pin 4 (test channel) and Pin 6 (digital output) must also be connected. The measured signals are then evaluated and further processed in a logic unit arranged downstream by the user (cf. technical data sheet).

The output signal of the oxygen measuring system is 4-20 mA.

	<p><u>IMPORTANT!</u> There must be a constant supply of power to the oxygen measuring system, otherwise condensate will form and this can destroy the oxygen measuring system.</p>
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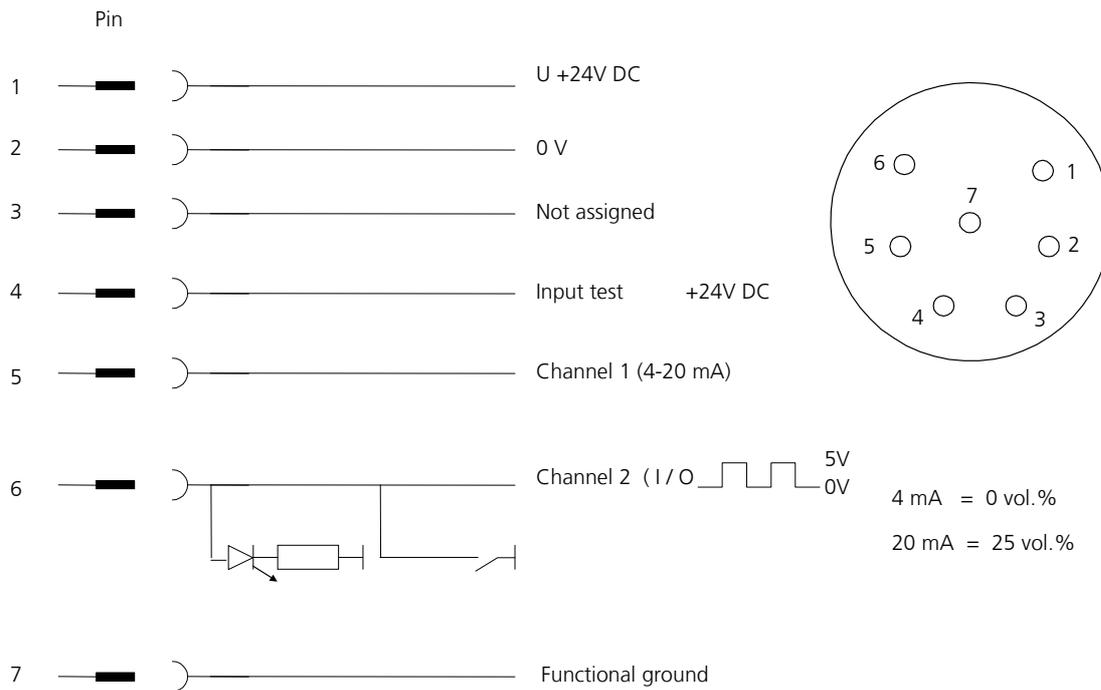


Fig. 3: Pin assignment



CAUTION!

In accordance with existing safety regulations, the oxygen measuring system must only be connected to suitable power supply units that comply with the valid technical regulations. It must be ensured that fuse protection is provided that is suitable for the power supply units used (SAFE ELECTRICAL ISOLATION)!

4. Operation

4.1 Commissioning

Before commissioning use the following list to check whether all requirements for trouble-free operation are met:

- Has the oxygen measuring system been installed?
- Is the oxygen measuring system accessible and visible in the compost heap?
- Has the ambient temperature been taken into account?
- Has the oxygen measuring system been connected?
- Is the power supply switched on?
- Are you sure that the connection cable is not laid next to high-tension power cable?
- Please bear in mind that this is a sensitive measuring instrument!

Next, carry out a test of the measured values. To do this, hold the insertion probe in fresh air for 5 minutes and then check the measured value on the downstream device. If this is $20.7 \text{ vol\%} \pm 1\%$ of full scale (0.25%), the oxygen measuring system is ready for use. Prepare a commissioning report (see section 9.4, Warranty).

4.2 Output signals and fault messages

The oxygen measuring system outputs two measuring signals through two different channels: These output signals have to be read and further processed in a downstream device according to the user's specifications.

The output signal of analog channel K1 is linear and lies between 4 and 20 mA with 20.7 vol% oxygen corresponding to 17.25 mA and 25 vol% corresponding to 20 mA.

Digital channel K2 emits a pulse-length modulated alternating signal (high phase 5V, low phase 0V; see Fig. 4). The length of the low phase is the measure for the oxygen concentration and will be calculated by the downstream device. An oxygen concentration of 0.1 vol% corresponds to 0.09 s and 25 vol% oxygen corresponds to 0.71 s.

If the alternating signal (low+high) falls outside a time window of 0.2 to 4 s (this corresponds to an error tolerance of 10%) or if it changes to a constant fault signal of 5 V, the measured value is outside the measuring range.

If the hardware is faulty, the output signal will remain constant at 0 V. Please notify the manufacturer and replace the device.

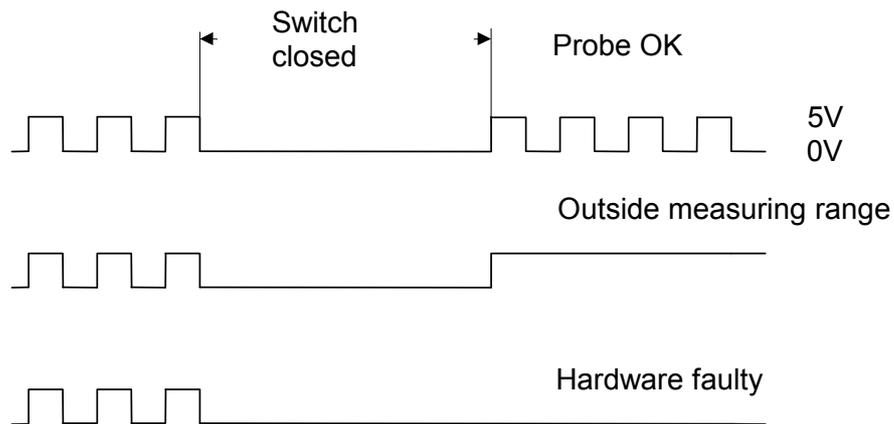


Fig. 4: Channel K2 output signals.

4.3 Calibration

The measuring system is designed such that no additional calibration is required even if the device is in operation for a long period of time. If required, electrical calibration is possible, but only if Pin 6 (channel 2, see Fig. 3) is connected. If there is a voltage cut-off, the newly calibrated value will return to the factory settings.



IMPORTANT!

The measuring system measures the oxygen partial pressure. According to Dalton's Law, this depends on the air pressure and relative humidity. Strong fluctuations of these parameter affect the calibration!

- The system calibrates itself in atmospheric air (i.e. 1013 mbar, 20.7 vol %oxygen $\pm 10\%$).
- To do this, pull the insertion probe out of the compost and hold it in fresh air for 30 seconds.
- Close switch S (Pin 6 or channel K2) for at least 10 seconds by means of a downstream device (see Fig. 3). The oxygen measuring system will now calibrate itself.
- If the newly measured oxygen concentration lies within the 10% tolerance range of the oxygen measuring system, the output signal from channel K2 will remain alternating.
- If the measured value is outside this tolerance range, channel K2 emits a fault signal of 5 V. In this case, check whether the sensor is exposed to enough atmospheric air and, if necessary, repeat the calibration. If the device continues to emit the fault signal, notify the manufacturer and replace the device.
- After successful calibration, the oxygen measuring system corrects the output signal from channel K1, whereby 20.7 vol% oxygen corresponds to 17.25 mA (25 vol% oxygen corresponds to 20 mA).



4.4 Function test

The oxygen measuring system is designed such that it can check that it is functioning correctly during operation. For this purpose Pins 4 and 6 must be connected (see Fig. 3). Ideally, the function test is carried out cyclically.

- Apply +24 V to Pin 4 to simulate a lower oxygen concentration than actually prevails at the oxygen measuring system.
- As a result, both the measured signals at the digital and analog outputs should drop by at least 10%.
- If this is not the case, then the oxygen measuring system is faulty and has to be replaced.
- After the test is completed, disconnect the +24 V again.

4.5 Fail-safety

If required, the oxygen measuring system can be operated in fail-safe mode. Please refer to the relevant section in the technical data sheet.

5. Maintenance and servicing



DANGER!

Mains voltage (230 V, 50 Hz).

Danger to life due to electric shock or burns.

Do not bring into contact with water.

The housing must only be opened by the manufacturer.

Electrical work should only be carried out by a qualified electrician.

Only install in a voltage-free state.



CAUTION!

The bar probe in the probe protection tube is hot (200° C).

There is a danger of fire and burn injuries if the probe protection tube is damaged!

Wear protective gloves.

Remove the probe protection tube from service immediately if it is damaged.



IMPORTANT!

The oxygen measuring system must only be opened and repaired by the manufacturer. Do not modify the oxygen measuring system and do not reconstruct it. Otherwise the oxygen measuring system might no longer measure the oxygen concentration reliably.

The oxygen measuring system and the connecting cable must be checked at least every six months by qualified personnel (see section 1.4) and a servicing report must be prepared. Always ensure that the interval between services meets safety requirements!

Check the measured values after each period of non-use or interruption of operation (see section 4.1). If the measured value is $20.7 \text{ vol\%} \pm 1\%$ of full scale (0.25%), the device is ready for use again. If, however, the measured value is outside this range, either inform the manufacturer or dealer, or else, if possible, carry out a calibration (see section 4.3) and a function test (see section 4.4).

Check the measured value and carry out a calibration and, if possible, a function test (see section 4.4) after every fault message.

i	<p><u>IMPORTANT!</u></p> <p>Carry out appropriate checks to ensure that:</p> <ol style="list-style-type: none">1.) the oxygen measuring system and its surroundings are clean, accessible and visible at all times2.) the openings on the probe protection tube are always clean and penetrable.
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Above and beyond such measures the oxygen measuring system is maintenance-free.

6. Decommissioning

Switch off the power supply, remove the temperature measuring system from the compost and clean it **carefully (do not use a steam jet cleaner!)**. Afterwards, check if there is any damage. Please refer to section 3.2 for information on storage.

7. Packaging and transport



This device is a measuring instrument with sensitive electronic components. When returning it, please use the appropriate class of packaging according to the applicable regulations.

8. Disposal

Obsolete devices should be rendered unusable immediately and disposed of according to the relevant regulations. Please contact your local authority for information about disposal.

9. Appendix

9.1 Spare parts

Cap 08-2301-00-00

Flange handle 080-028

Countersunk screw, on request

Bar probe, 400 mm with membrane, on request

Probe protection tube, complete, 080-048

9.2 Harmful substances

As the oxygen sensor contains zirconium dioxide and platinum, it can be destroyed by the following substances:

- Heavy metals
- Sulphuric compounds
- Silicone vapours
- Fluorine
- NH₃ (from 1000 ppm)
- Halogenated hydrocarbons (from 100 ppm)
- Phosphate ester
- Chlorine
- SF₆
- Carbons
- Salts
- Long periods in a reducing atmosphere

Dust, vibration, dirt, humidity, oils, grease, furnace cleaning agents, heavy heating oil, pyrolysis gases and silicone oxide shorten the service life of the oxygen sensor.

This list is not guaranteed exhaustive.

9.3 Troubleshooting

Fault	Possible causes
No output signal	Measuring system not connected to the power supply
	Connecting cable or connector plug faulty
	The bar probe is no longer firmly in place
	Plug-in contacts dirty, corroded or damp
Incorrect value displayed	Probe protection tube is dirty
	The bar probe is no longer firmly in place
Measuring system does not react in ambient air	The bar probe is no longer firmly in place

If the fault cannot be rectified, please notify the dealer concerned.

9.4 Copyright

The copyright to these operating instructions is exclusively reserved to **Euro-Gas**. Reproduction, translation and duplication in whole or in part without written authorisation is strictly prohibited.

9.5 Warranty

 We the manufacturer grant a warranty for this device for a period of 6 months from commissioning, documented by a commissioning report. Within this warranty period we will at our discretion repair or replace the device free of charge if found to be defective as to workmanship or material.

The warranty excludes: damages attributable to improper use, normal wear (e.g. sensor element, sintered cap), and defects that have only a negligible influence on the device's value or suitability for use.

Liability for the functioning of the oxygen measuring system shall pass at all events to the owner or operator if the oxygen measuring system is improperly maintained or repaired or if it is used other than for its intended purpose. **Euro-Gas** accepts no liability for damage caused by failure to observe the above information.

The warranty expires in the event that work is carried out by agents we have not authorised or if parts are used other than original spare parts.

Claims under the warranty may be made in all countries where this device is sold by authorised dealers.

In the event of any claim under the warranty, please return the device to us. The buyer shall bear the costs of transportation and the risk while the device is in transit. The execution of work under the warranty does not affect the warranty period in any way.

The manufacturer accepts no liability for printing errors or any damage resulting therefrom.

By the nature of the technology used, any sensor can potentially fail to meet specification without warning. Euro-Gas makes every effort to ensure reliability of all sensors but where life safety is a performance requirement of the product and, where practical, Euro-Gas recommends that all gas sensors and instruments using sensors are checked for response to gas before use.

The data contained in this document is believed to be accurate and reliable. The data given is for guidance only. Euro-Gas Management Services Ltd accepts no liability for any consequential losses, injury or damage resulting from the use of this datasheet or the information contained in it. Customers should test the sensors under their own conditions to ensure that the sensors are suitable for their own requirements and in accordance with the plans and circumstances of the specific project and any standards/regulations pertaining to the country in which the sensors will be utilised. Performance characteristics on this data sheet outline the performance of newly supplied sensors. Output signal can drift below the lower limit over time. This datasheet is not intended to form the basis of a contract and in the interest of product improvement, Euro-Gas reserves the right to alter design features and specifications without notice. 03/19

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