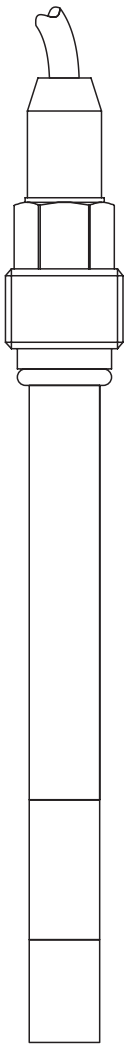
Operating manual

Oxi ML 41

D. O. sensor



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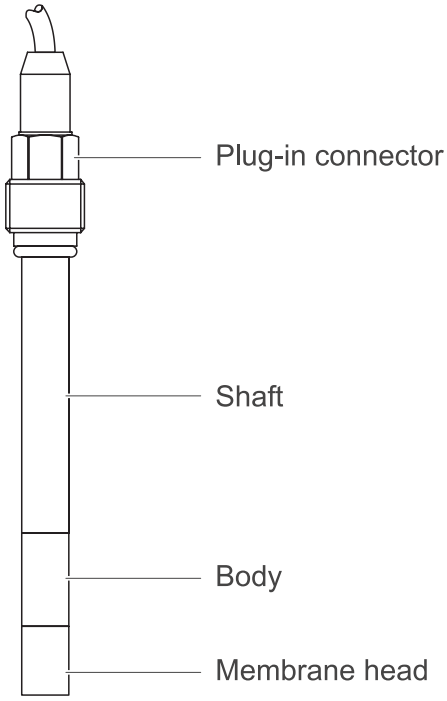
Accuracy when going to press

The use of advanced technology and the high quality standard of our instruments are the result of continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Note
The latest version of the present operating manual can be found on the Internet under www.WTW.com.

Contents

1 Overview



2 Safety

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the sensor. Consequently, all responsible personnel must read this operating manual before working with the sensor.
The operating manual must always be available within the vicinity of the sensor.

Target group and user qualification

The D. O. sensor Oxi ML 41 was developed for online measurement. Some maintenance activities, e.g. changing the electrolyte solution, require the safe handling of chemicals. Thus, we assume that the maintenance personnel is familiar with the necessary precautions to take when dealing with chemicals as a result of their professional training and experience.

General safety instructions

Safety instructions in this operating manual are indicated by the warning symbol (triangle) in the left column. The signal word (e.g. "Caution") indicates the danger level:

Caution
indicates instructions that must be followed precisely in order to avoid slight injuries or damage to the sensor or the environment.

Other labels

Note
indicates notes or helpful hints that draw your attention to special features and give further clarification to the instructions. Refer to the *Table of Contents* to easily find specific topics and to learn about unfamiliar terms.

Authorized use

Authorized use of the D. O. sensor Oxi ML 41 consists exclusively of the measurement of dissolved oxygen (D. O.) in drinking water, swimming pool water and process water.
The technical specifications as given in chapter TECHNICAL DATA must be observed. Only the operation and running of the measuring cell according to the instructions given in this operating manual is authorized. Any other use is considered to be **unauthorized**.

Function and operational safety

The sensor left the factory in a safe and secure technical condition. The failure-free function and operational safety of the sensor is only guaranteed if the generally applicable safety measures and the special safety instructions in this operating manual are followed during its use.

The smooth functioning and operational safety of the sensor can only be guaranteed under the climatic conditions specified in the chapter Technical data.

Safe operation

If safe operation is no longer possible, the sensor must be taken out of operation and secured against inadvertent operation.
Safe operation is no longer possible if the sensor:

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

If you are in any doubt, contact the supplier of your sensor.

Obligations of the operator

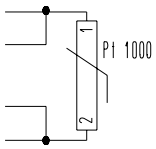
The operator of the sensor must ensure that the following rules and regulations are followed when dealing with hazardous substances:

- EEC directives for protective labor legislation
- National protective labor legislation
- Accident prevention regulations

3 Installation and commissioning

The D. O. sensor Oxi ML 41 is delivered ready to measure, in a storage vessel filled with some water. The sensor can be taken out of the vessel after loosening the coupling ring. Before putting the sensor into operation, carefully dab off the liquid film on the membrane with a lint-free paper towel.

The D. O. sensor is connected to the meter according to the operating manual of the meter. This is done with a permanently fixed cable with free wire ends. The wire assignment is given in the following table:

Wire color	**Sensor connection**	**Circuit diagram**
Shield	Anode	
white	Cathode	
Gray	Pt 1000 (1)	
Green	Pt 1000 (1)	
Brown	Pt 1000 (2)	
Yellow	Pt 1000 (2)	

During longer storage periods, adsorption layers or surface oxides may possibly on the Pt cathode and reduce the sensitivity of the sensor. In this case proceed as described in the section, "Maintenance“. There is also described how to restore the operational capability of the cathode.

30 minutes after the meter was switched on the connected sensor is sufficiently polarized and ready to measure. High reproducibility and stability of measured values are achieved if the sensor is subjected to permanent polarization.

4 Calibration

During calibration, the amplification of the meter is individually adjusted to the sensitivity of the sensor. Calibration can be carried out with air, with air-saturated water, with calibration gases or measuring media with a known oxygen concentration. To do so, please observe the operating manuals of the meters.

Calibration in air:
Calibration in air is easily carried out. The sensor is put in a storage vessel with water vapor-saturated air. A water film on the membrane falsifies the calibration. If necessary, carefully dab off the membrane with a lint-free paper towel. To achieve high measurement accuracy we recommend a calibration duration of 30 minutes. For lower measurement accuracy requirements it is sufficient to calibrate the sensor in the ambient air. For the following measurement in water, a saturation value of 102 % or 21.3 percent by volume oxygen has to be set. The factor 1.02 takes sensor-specific processes on the membrane surface into account that become effective during the change from air to water.

Calibration in water:
Calibration is carried out with air-saturated water at a constant temperature. For these purposes, a vessel is filled with water and air is introduced through a fine pored sinter plate. While doing so the temperature must absolutely be kept constant. The balancing for air-saturated water takes approx. one hour. Strong ventilation can cause over-saturation. Stirring creates the flow required for measurement and calibration (≥ 12 cm/s). At the meter, 100 % air saturation or 20.9 percent by volume oxygen is adjusted.

Calibration by comparison measurement:
An additional possibility is to enter or set an oxygen concentration that was determined by a comparison measurement, e.g. by chemical determination according to Winkler.

5 Measurement

Both with temperature compensated D. O. measurement and temperature measurement it is necessary for the temperature sensor integrated in the sensor to be washed round by the test sample (depth of immersion at least 6 cm). As amperometric measurement requires a minimum flow in front of the sensor membrane, measurement either has to take place in flowing media or the sensor must be moved during measurement.

On commissioning, the sensor is subjected to a polarization voltage, so that a diffusion current flows. After switching on it takes several minutes until a stationary condition has developed and the sensor is ready to measure. High reproducibility and stability of measured values are achieved if the sensor is subjected to permanent polarization.

6 Maintenance

6.1 General information

Maintenance is required if either the membrane head is defective or the sensor cannot be calibrated or the polarization time considerably exceeds the specified value.
Maintenance activities are: cleaning the membrane, possibly exchanging the electrolyte solution, exchanging the membrane head and cleaning the electrode system. The maintenance interval depends on the respective measurement conditions, especially on the contamination level of the test sample and the impact of interfering substances, e.g. H_2S, on the electrochemical measuring system. To restore the full functional capability of the sensor after a malfunction we recommend proceeding with the steps described in detail below:

1. Cleaning the membrane with a moist, lint-free paper towel.
   Without disassembling the membrane head, carefully rinse the membrane with water and clean it using a moist paper towel. If recalibrating is still not possible after this or the data of the sensor considerably differs from its specification, the electrolyte solution and membrane head have to be replaced.
2. Exchange of electrolyte solution and membrane head.
   For this the membrane head is unscrewed and the electrodes are visually inspected. The electrodes may have to be regenerated.
3. If necessary, regeneration of the electrodes

6.2 Exchange of electrolyte solution and membrane head, regeneration of the cathode

Steps:

1. We recommend disconnecting the sensor from the meter for the exchange of electrolyte solution and membrane head. If the cathode should be regenerated additionally (step 5), the sensor has to be disconnected from the meter.
2. Unscrew the membrane head

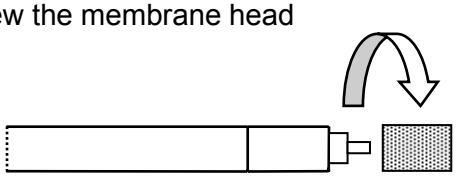


Figure 3

3. Rinse the electrode system with deionized water

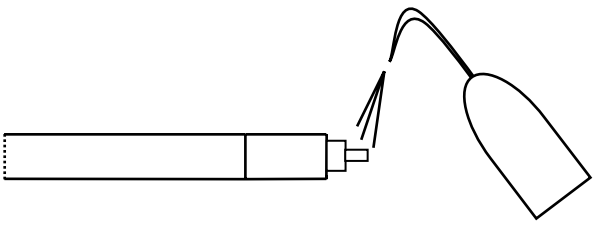


Figure 4

4. Carefully wipe the silver/silver chloride anode with a paper towel.
   Generally, this step is sufficient. The anode is normally covered with a silver chloride layer colored brownish or purple. Do not in any case remove this coating. After long-term use, changes can occur at the anode causing malfunctions of the sensor. Only in these extremely rare cases carry out the steps as described in section "Regenerating the anode“.

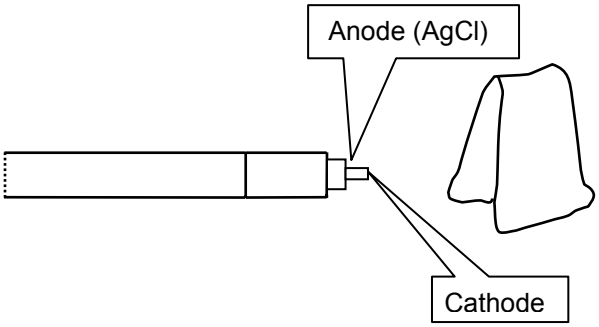


Figure 5

5. Regenerate the cathode

Note
For the regeneration of the cathode the sensor must be disconnected from the meter.

The condition of the cathode considerably affects the sensitivity of the sensor. During measurements, i. e. in the polarized condition, silver coatings develop on the cathode surface. If the sensor is stored for a longer period (>2 months) without being polarized, the surface condition can also change due to the development of surface oxides. These deposits have to be removed. Removing them has to be done very carefully because even small scratches will affect the measuring function.

To regenerate the cathode, proceed as follows:

- Moisten the provided polishing strip with water and position it on a solid surface.

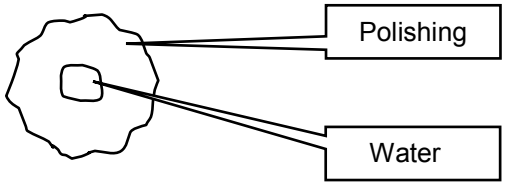


Figure 6

- Position the sensor vertically on the polishing strip while exerting slight pressure on it, similar to writing with a pencil. Then draw it over the polishing strip several times in a straight line while exerting slight pressure. Repeat the process moving the sensor in a direction vertical to the previous one.

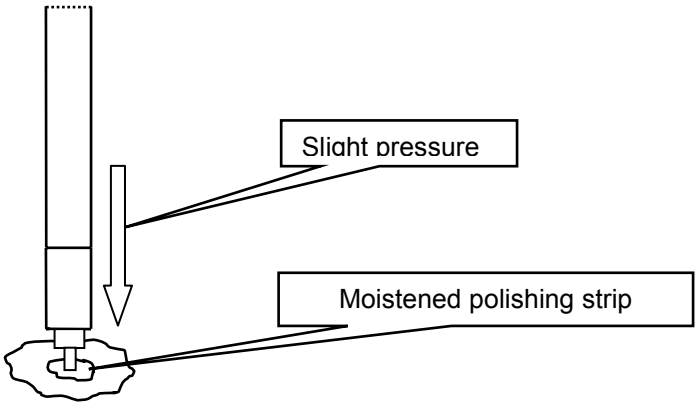


Figure 7

This procedure is intended to remove a layer that is only a few µm thick from the cathode, i. e. the cathode surface should only be polished.

6. Fill a new membrane head with electrolyte solution (1 vial)

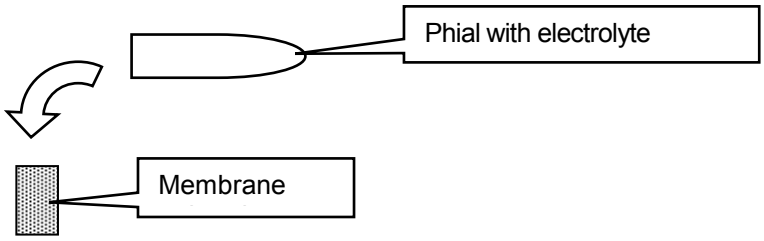


Figure 8

7. Rinse the electrode system with electrolyte solution.
   When doing so, no electrolyte solution must remain in the space between the metal part and glass shaft (remove with paper towel if necessary).

8. Connect the sensor with the meter.

9. Screw the membrane head on the body.
   When doing so, hold the sensor top down, tilted, and with a paper towel dap off the excess electrolyte solution escaping at the thread. Screw on the membrane head slowly to avoid any overpressure inside. The reading of the meter rises to 100 ... 200 % saturation with every turn of the membrane head. If there is a noticeable mechanical resistance, wait after each turning movement (a few degrees only) so the internal overpressure can be compensated. The membrane must absolutely not be bloated.

10. After approx. 30 to 60 minutes, the sensor is ready for operation.

6.3 Regeneration of the anode

Steps:

Note
The anode is normally covered with a silver chloride layer colored brownish or purple. Do not in any case remove this coating. After long-term use, changes can occur at the anode causing malfunctions of the sensor. Only in these extremely rare cases regenerate the anode as described below.

Note
For the regeneration of the anode the sensor must be disconnected from the meter.

Steps 1 to 3:
Carry out the steps 1 to 3 as described in section "Changing the electrolyte solution and membrane head“.

4. Carefully dab off the silver/silver chloride anode with a paper towel (see figure 5).
   A gray or white coating on the anode is caused by silver oxide forming if the electrolyte solution no longer contains enough KCl. In this case the electrode body is immersed in 3 mol/L $(NH_4)_2CO_3$ solution (anode cleaner) for approx. 10 min. Afterwards rinse it with sufficient deionized water.

Steps 5 to 8:
Carry out these steps as described in section "Changing the electrolyte solution and membrane head“ under points 6 to 9.

9. After this treatment, the sensor may be ready to measure only after several hours.

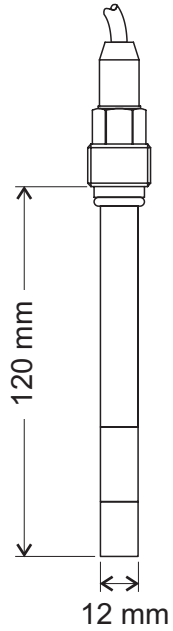
7 Replacement parts and accessories

Here you find the recommended accessories and replacement parts that you can order from WTW.

If for any reason technical assistance is needed regarding this instrument please do not hesitate to contact the WTW technical services department.

Accessories	Model	WTW order no.
Accessory kit for D. O. sensor Oxi ML 41, comprising: - 3 membrane heads - 4 pieces polishing strip - paper towel - 2 O-rings 9x1 Vi563 - 10 vials of electrolyte solution	ZBK-Oxi ML 41	202 300

8 Technical data



Measuring principle	Membrane-covered, amperometric sensor (Clark cell)
Application range	Swimming pool water, drinking water and process water
Measuring range	0 ... 20 mg/L O_2 0 ... 200 % air saturation
Temperature sensor	Platinum measurement resistor Pt 1000
Temperature compensation	Automatic in the range 5 ... 50 °C by means of integrated temperature sensor B(< 20 °C): -2600 K B(> 20 °C): -2300 K
Flow influence at T=25 °C	< 6 %
Response time at T=25 °C	t_{90} (90 % of the final value display after) < 30 s
Application temperature	-5 ... 45 °C
Connection cable	1 m multi-wire, screened fixed cable without plug, twistable PG 13.5 screw coupling at the shaft
Materials	ABS, stainless steel 1.4571, polysulphone, silicone
Pressure resistance	max. 3 bar

9 Table: Oxygen saturation concentration

Oxygen saturation concentration (in mg/L) of water in equilibrium with air at a total pressure of the water vapor-saturated atmosphere of 1013 mbar in dependency of the temperature.

Values according to DIN EN 25814 and DIN 38408, part 23

Temperature in °C	**.0**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**
0	14.64	14.60	14.55	14.51	14.47	14.43	14.39	14.35	14.31	14.27
1	14.23	14.19	14.15	14.10	14.06	14.03	13.99	13.95	13.91	13.87
2	13.83	13.79	13.75	13.71	13.68	13.64	13.60	13.56	13.52	13.49
3	13.45	13.41	13.38	13.34	13.30	13.27	13.23	13.20	13.16	13.12
4	13.09	13.05	13.02	12.98	12.95	12.92	12.88	12.85	12.81	12.78
5	12.75	12.71	12.68	12.65	12.61	12.58	12.55	12.52	12.48	12.45
6	12.42	12.39	12.36	12.32	12.29	12.26	12.23	12.20	12.17	12.14
7	12.11	12.08	12.05	12.02	11.99	11.96	11.93	11.90	11.87	11.84
8	11.81	11.78	11.75	11.72	11.69	11.67	11.64	11.61	11.58	11.55
9	11.53	11.50	11.47	11.44	11.42	11.39	11.36	11.33	11.31	11.28
10	11.25	11.23	11.20	11.18	11.15	11.12	11.10	11.07	11.05	11.02
11	10.99	10.97	10.94	10.92	10.89	10.87	10.84	10.82	10.79	10.77
12	10.75	10.72	10.70	10.67	10.65	10.63	10.60	10.58	10.55	10.53
13	10.51	10.48	10.46	10.44	10.41	10.39	10.37	10.35	10.32	10.30
14	10.28	10.26	10.23	10.21	10.19	10.17	10.15	10.12	10.10	10.08
15	10.06	10.04	10.02	9.99	9.97	9.95	9.93	9.91	9.89	9.87
16	9.85	9.83	9.81	9.70	9.76	9.74	9.72	9.70	9.68	9.66
17	9.64	9.62	9.60	9.58	9.56	9.54	9.53	9.51	9.49	9.47
18	9.45	9.43	9.41	9.39	9.37	9.35	9.33	9.31	9.30	9.28
19	9.26	9.24	9.22	9.20	9.19	9.17	9.15	9.13	9.11	9.09
20	9.08	0.06	9.04	9.02	9.01	8.99	8.97	8.95	8.94	8.92
21	8.90	8.88	8.87	8.85	8.83	8.82	8.80	8.78	8.76	8.75
22	8.73	8.71	8.70	8.68	8.66	8.65	8.63	8.62	8.60	8.58
23	8.57	8.55	8.53	8.52	8.50	8.49	8.47	8.46	8.44	8.42
24	8.41	8.39	8.38	8.36	8.35	8.33	8.32	8.30	8.28	8.27
25	8.25	8.24	8.22	8.21	8.19	8.18	8.16	8.15	8.14	8.12
26	8.11	8.09	8.08	8.06	8.05	8.03	8.02	8.00	7.99	7.98
27	7.96	7.95	7.93	7.92	7.90	7.89	7.88	7.86	7.85	7.83
28	7.82	7.81	7.79	7.78	7.77	7.75	7.74	7.73	7.71	7.70
29	7.69	7.67	7.66	7.65	7.63	7.62	7.61	7.59	7.58	7.57
30	7.55	7.54	7.53	7.51	7.50	7.49	7.48	7.46	7.45	7.44
31	7.42	7.41	7.40	7.39	7.37	7.36	7.35	7.34	7.32	7.31
32	7.30	7.29	7.28	7.26	7.25	7.24	7.23	7.21	7.20	7.19
33	7.18	7.17	7.15	7.14	7.13	7.12	7.11	7.09	7.08	7.07
34	7.06	7.05	7.04	7.02	7.01	7.00	6.99	6.98	6.97	6.96
35	6.94	6.93	6.92	6.91	6.90	6.89	6.88	6.87	6.85	6.84
36	6.83	6.82	6.81	6.80	6.79	6.78	6.77	7.75	6.74	6.73
37	6.72	6.71	6.70	6.69	6.68	6.67	6.66	6.65	6.64	6.63
38	6.61	6.60	6.59	6.58	6.57	6.56	6.55	6.54	6.53	6.52
39	6.51	6.50	6.49	6.48	6.47	6.46	6.45	6.44	6.43	6.42
40	6.41	6.40	6.39	6.38	6.37	6.36	6.35	6.34	6.33	6.32

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