OxyGuard®

Dissolved Oxygen Probe

Standard type

USER MANUAL

D02 Standard Probe manual gb 0903

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1. DESCRIPTION

1.1 The OxyGuard Probe

The OxyGuard oxygen probe is a galvanic oxygen sensor that produces an electrical output proportional to the oxygen present in the medium it is placed in. It consists of an upper part with cathode, anode and cable, and a cap with membrane and electrolyte. The probe can be supplied as an oxygen probe alone, with built-in NTC temperature sensor or with built-in Pt100 temperature sensor.

Dissolved oxygen is either measured in % saturation or mg/l. The units ppm can be used instead of mg/l.

Membranes for mg/l and % sat measurements differ. The mg/l membrane sinks in water, the % sat membrane floats.

Oxygen diffuses through the membrane onto the cathode, where it reacts chemically and then combines with the anode. This chemical process develops an electrical current, which is converted into a millivolt output signal through a built-in resistor.

The probe has built in temperature compensation either for mg/l or % saturation depending on the choice of membrane. Unless otherwise specified the probes are equipped with mg/l membranes. The membrane can, however, be changed to the % saturation type in a matter of minutes.

The probe is designed for use at temperatures between 0 and 40°C, liquid movement down to approx. 1 cm/sec (measured at 7 mg/l and 13°C) and depths to 100 m. Probes for higher temperatures or greater depths are available on request.

OxyGuard oxygen probes do NOT need regular maintenance or service – just keep the membrane reasonably clean

If you can calibrate to the correct value you should not open the probe, even if it has been in use for many years. If the membrane should be damaged membrane replacement will, of course, be necessary, but the procedure, which also renovates the probe, is easy and can be performed on-the-spot by anyone, as described later in this manual. Spares are shipped with the probe.

OxyGuard manufacture an anti-fouling cap for use in situations where access to the probe is difficult or where deposits build-up so heavily and quickly that frequent cleaning is necessary.

Deposits develop on all surfaces in any biologically active system, and a deposit that builds up on the membrane of an oxygen probe will change the sensitivity of that probe. OxyGuard probes are designed so that deposits have little influence, but for the greatest accuracy you should keep the probe clean, just as it was when you calibrated it. Deposits should be wiped off the membrane with a cloth or paper. The cleaning frequency will depend on the accuracy desired, how fast deposits build up and on their exact nature.

1.2 Which kind of transmitter can be used with the OxyGuard Probe?

As indicated above the probe can be considered a low impedance millivolt generator. Its output of about 30 mV with the probe in air is temperature compensated and linearly proportional to the oxygen concentration, either in mg/l or % saturation depending on the choice of membrane.

OxyGuard transmitters are, of course, optimized for use with the OxyGuard probe.

The output impedance is very low (< 1 kilohm) so noise problems normally do not exist. However, it is important that the input impedance of the following transmitter is at least 2 megohms in order not to disturb the temperature compensation. It is also extremely important that inputs from probes are galvanically isolated from each other if more than one probe is connected to the same electronics. Similarly, probes must be galvanically isolated from anything else that can in any way have electrical contact with the water that is measured in.

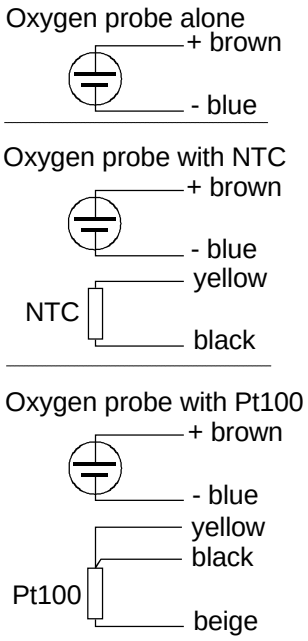
If you are in doubt, contact your dealer.

2. INSTALLATION

The **OxyGuard** probe is easy to install. It should be placed where there is some movement in the water - 1 cm/sec is enough at 7 mg/l and 13°C. Ensure that the probe cannot strike against the tank wall or similar, and don't mount it directly above diffusers etc.

Several forms of mounting device are available from OxyGuard. In fish farm ponds the probe is often fitted with a membrane protector and hung in its cable. In sewage treatment plants and similar the use of a **Pioneer** or **DAT** mounting system is recommended. The Pioneer places the probe in a flexible mount approximately 30 cm under the surface and 50 cm from the tank wall. The DAT places the probe in a fixed mounting closer to the tank wall.

Each probe is connected using ordinary 2-core cable, and it is fitted with 5 meters of PU cable unless otherwise specified. The oxygen probe alone has a two-core cable. The brown wire is positive, the blue negative. Use the junction box supplied with the probe when extending the cable. There is no limit to cable length. All cable types can be used. The probe with built-in NTC temperature sensor has a four-lead cable, that with a Pt100 sensor a five-lead cable.



3. DIRECTIONS FOR USE

3.1 Calibration

Calibration is carried out by placing the probe in air or air saturated water, waiting for temperature equalization then adjusting the transmitter or electronics connected so that the output corresponds to the calibration value. If you are measuring % saturation the calibration value is always 100%. If you are measuring mg/l (ppm) temperature, the barometric pressure and the water salinity all affect the calibration value.

The same calibration values are used for both air and saturated water.

Calibration against various "pocket" test kits cannot be recommended.

The probe must have the same temperature as the water or air it is calibrated in and must be allowed to attain this temperature before being calibrated. Any robust long-life probe such as the **OxyGuard** can take up to an hour to respond to a 10 degree temperature change in air, which only takes 10 minutes in water. This must be taken into consideration when calibrating.

An easy way to calibrate is to use the **OxyGuard EasyCal** calibrator. Just place the probe in the **EasyCal** holder, return it to the water and read the calibration value from the **EasyCal** display! No need to refer to tables, and it only takes a few minutes.

When you use the EasyCal the probe is not subjected to a temperature change since calibration is performed with the probe in its normal position in the water.

If you do not use the EasyCal take the probe up from the water, wipe the membrane dry, and hang the probe in free air, away from direct sunlight. If necessary wrap aluminium foil around it. You must now wait for temperature equalization. When the probe output is stable adjust the transmitter or electronics connected to give the correct output, corresponding to the calibration value found from the tables, as explained below.

For those who measure % sat an EasyCal without display is available.

Calibration value for systems measuring % saturation

The calibration value for systems measuring % sat is always 100. For these systems, and only for these systems, temperature, barometric pressure and salinity have no influence.

IMPORTANT
As stated above, probes for % sat measurements have different membranes to probes for mg/l (ppm) systems.

Calibration value for systems measuring mg/l (ppm)

For these measurements adjust until the output corresponds to the appropriate value from the calibration tables. Temperature, pressure and salinity affect the value. The first table at the end of this section shows values for various temperatures and air pressures, the other values for various temperatures and salinities at 760 mbar.

It is essential to correct for temperature - use the air temperature near the probe. At high altitudes, or for greater accuracy, a correction must be made for pressure. The salinity should be corrected for in salt-water measurements.

Salinity can be measured with the OxyGuard Refractometer.

For a simple calibration at low altitudes assume a normal barometric pressure of 760 mm Hg.

How often should calibration be performed?

Unfortunately, it is not possible to answer this question. Under ideal conditions (in air) the probe can keep its calibration for many months. In use in water the actual conditions (e.g. the nature of deposit build-up) and the desired accuracy will dictate calibration frequency. It is very important that calibration is performed with care. Give the probe good time to stabilize, check the barometer and decide if correction is necessary. Check the salinity if you measure in salt water.

Remember that no measurement is more accurate than the calibration.

3.2 Maintenance

The probe's membrane must be kept free from deposits. ALL surfaces in a biologically active system will be covered by a film composed mostly of bacteria. This bacteria film acts as a diffusion barrier for the oxygen that must diffuse through the membrane. The membrane must, therefore, be cleaned at regular intervals, the frequency depending on the actual conditions. Cleaning can be performed with a cloth or soft paper. The membrane is strong and not easily damaged, but do not try to scratch it clean with a fingernail!

The probe should not be taken apart unless the membrane is damaged or you cannot calibrate to the correct value after long use.

There is no need to exchange the electrolyte regularly, and there is no sensor element that will need replacing!

Other Points Worth Considering

Even though the OxyGuard probe is one of the most robust available, it should be treated carefully. It measures of few thousandths of a gram of oxygen, which it must "drag" out of the water around it. So, if, in your opinion, it performs mysteriously, ask your dealer or us about it. You are certain to get the help you need!

3.3 CALIBRATION TABLE - mg/l - FRESH WATER

Barometric Pressure												
mm Hg		700	710	720	730	740	750	**760**	770	780	790	800
mbar		933	946	960	973	986	1000	**1013**	1026	1040	1053	1066
Temp												
°C	°F											
0	32.0	13.4	13.6	13.8	14.0	14.2	14.4	**14.6**	14.8	15.0	15.2	15.4
1	33.8	13.1	13.3	13.5	13.6	13.8	14.0	**14.2**	14.4	14.6	14.8	14.9
2	35.6	12.7	12.9	13.1	13.3	13.4	13.6	**13.8**	14.0	14.2	14.4	14.5
3	37.4	12.4	12.6	12.7	12.9	13.1	13.3	**13.4**	13.6	13.8	14.0	14.2
4	39.2	12.1	12.2	12.4	12.6	12.7	12.9	**13.1**	13.3	13.4	13.6	13.8
5	41.0	11.8	11.9	12.1	12.3	12.4	12.6	**12.8**	12.9	13.1	13.3	13.4
6	42.8	11.5	11.6	11.8	11.9	12.1	12.3	**12.4**	12.6	12.8	12.9	13.1
7	44.6	11.2	11.3	11.5	11.6	11.8	12.0	**12.1**	12.3	12.4	12.6	12.8
8	46.4	10.9	11.1	11.2	11.4	11.5	11.7	**11.8**	12.0	12.1	12.3	12.5
9	48.2	10.6	10.8	10.9	11.1	11.2	11.4	**11.5**	11.7	11.9	12.0	12.2
10	50.0	10.4	10.5	10.7	10.8	11.0	11.1	**11.3**	11.4	11.6	11.7	11.9
11	51.8	10.1	10.3	10.4	10.6	10.7	10.9	**11.0**	11.2	11.3	11.5	11.6
12	53.6	9.9	10.1	10.2	10.3	10.5	10.6	**10.8**	10.9	11.0	11.2	11.3
13	55.4	9.7	9.8	10.0	10.1	10.2	10.4	**10.5**	10.7	10.8	10.9	11.1
14	57.2	9.5	9.6	9.8	9.9	10.0	10.2	**10.3**	10.4	10.6	10.7	10.8
15	59.0	9.3	9.4	9.5	9.7	9.8	9.9	**10.1**	10.2	10.3	10.5	10.6
16	60.8	9.1	9.2	9.3	9.5	9.6	9.7	**9.9**	10.0	10.1	10.2	10.4
17	62.6	8.9	9.0	9.1	9.3	9.4	9.5	**9.7**	9.8	9.9	10.0	10.2
18	64.4	8.7	8.8	9.0	9.1	9.2	9.3	**9.5**	9.6	9.7	9.8	10.0
19	66.2	8.5	8.7	8.8	8.9	9.0	9.1	**9.3**	9.4	9.5	9.6	9.7
20	68.0	8.4	8.5	8.6	8.7	8.8	9.0	**9.1**	9.2	9.3	9.4	9.6
21	69.8	8.2	8.3	8.4	8.5	8.7	8.8	**8.9**	9.0	9.1	9.3	9.4
22	71.6	8.0	8.2	8.3	8.4	8.5	8.6	**8.7**	8.8	9.0	9.1	9.2
23	73.4	7.9	8.0	8.1	8.2	8.3	8.4	**8.6**	8.7	8.8	8.9	9.0
24	75.2	7.7	7.8	8.0	8.1	8.2	8.3	**8.4**	8.5	8.6	8.7	8.8
25	77.0	7.6	7.7	7.8	7.9	8.0	8.1	**8.2**	8.4	8.5	8.6	8.7
26	78.8	7.5	7.6	7.7	7.8	7.9	8.0	**8.1**	8.2	8.3	8.4	8.5
27	80.6	7.3	7.4	7.5	7.7	7.7	7.8	**7.9**	8.1	8.2	8.3	8.4
28	82.4	7.2	7.3	7.4	7.5	7.6	7.7	**7.8**	7.9	8.0	8.1	8.2
29	84.2	7.1	7.2	7.3	7.4	7.5	7.6	**7.7**	7.8	7.9	8.0	8.1
30	86.0	6.9	7.0	7.1	7.2	7.3	7.4	**7.5**	7.6	7.7	7.8	7.9
31	87.8	6.8	6.9	7.0	7.1	7.2	7.3	**7.4**	7.5	7.6	7.7	7.8
32	89.6	6.7	6.8	6.9	7.0	7.1	7.2	**7.3**	7.4	7.5	7.6	7.7
33	91.4	6.6	6.7	6.8	6.9	7.0	7.1	**7.2**	7.3	7.4	7.5	7.5
34	93.2	6.5	6.6	6.7	6.8	6.9	7.0	**7.0**	7.1	7.2	7.3	7.4
35	95.0	6.4	6.5	6.6	6.7	6.8	6.8	**6.9**	7.0	7.1	7.2	7.3
36	96.8	6.3	6.4	6.5	6.6	6.6	6.7	**6.8**	6.9	7.0	7.1	7.2
37	98.6	6.2	6.3	6.4	6.5	6.5	6.6	**6.7**	6.8	6.9	7.0	7.1
38	100.4	6.1	6.2	6.3	6.4	6.4	6.5	**6.6**	6.7	6.8	6.9	7.0
39	102.2	6.0	6.1	6.2	6.3	6.3	6.4	**6.5**	6.6	6.7	6.8	6.9
40	104.0	5.9	6.0	6.1	6.2	6.2	6.3	**6.4**	6.5	6.6	6.7	6.7

3.4 CALIBRATION TABLE - SALT WATER APPLICATIONS

Temp		Salinity - parts per thousand				
		0	10	20	30	40
°C	°F					
0	32.0	14.6	13.6	12.7	11.9	11.1
1	33.8	14.2	13.3	12.4	11.6	10.8
2	35.6	13.8	12.9	12.1	11.3	10.6
3	37.4	13.4	12.6	11.8	11.0	10.3
4	39.2	13.1	12.3	11.5	10.7	10.0
5	41.0	12.8	11.9	11.2	10.5	9.8
6	42.8	12.4	11.6	10.9	10.2	9.6
7	44.6	12.1	11.4	10.7	10.0	9.4
8	46.4	11.8	11.1	10.4	9.8	9.4
9	48.2	11.5	10.8	10.2	9.5	8.9
10	50.0	11.3	10.6	9.9	9.3	8.7
11	51.8	11.0	10.3	9.7	9.1	8.6
12	53.6	10.8	10.1	9.5	8.9	8.4
13	55.4	10.5	9.9	9.3	8.7	8.2
14	57.2	10.3	9.7	9.1	8.6	8.0
15	59.0	10.1	9.5	8.9	8.4	7.9
16	60.8	9.9	9.3	8.7	8.2	7.7
17	62.6	9.7	9.1	8.6	8.1	7.6
18	64.4	9.5	8.9	8.4	7.9	7.4
19	66.2	9.3	8.7	8.2	7.7	7.3
20	68.0	9.1	8.6	8.1	7.6	7.2
21	69.8	8.9	8.4	7.9	7.5	7.0
22	71.6	8.7	8.2	7.8	7.3	6.9
23	73.4	8.6	8.1	7.6	7.2	7.8
24	75.2	8.4	7.9	7.5	7.1	6.7
25	77.0	8.2	7.8	7.4	7.0	6.6
26	78.8	8.1	7.6	7.2	6.8	6.5
27	80.6	7.9	7.5	7.1	6.7	6.4
28	82.4	7.8	7.4	7.0	6.6	6.2
29	84.2	7.7	7.3	6.9	6.5	6.1
30	86.0	7.5	7.1	6.8	6.4	6.1
31	87.8	7.4	7.0	6.6	6.3	6.0
32	89.6	7.3	6.9	6.5	6.2	5.9
33	91.4	7.2	6.8	6.4	6.1	5.8
34	93.2	7.0	6.7	6.3	6.0	5.7
35	95.0	6.9	6.6	6.2	5.9	5.6
36	96.8	6.8	6.5	6.1	5.8	5.5
37	98.6	6.7	6.4	6.1	5.7	5.5
38	100.4	6.6	6.3	6.0	5.7	5.4
39	102.2	6.5	6.2	5.9	5.6	5.3
40	104.0	6.4	6.1	5.8	5.5	5.2

The table is referred to a barometric pressure of 760 mm Hg.
At other air pressures, the values should be corrected in the following way:

$$\text{Corrected value} = \text{Table value} \times \frac{\text{Actual pressure}}{760}$$

Example:

Temperature = 14°C

Salinity = 30 ppt

Air pressure = 742 mm Hg

$$\text{Corrected value} = 8.6 \times \frac{742}{760} = \mathbf{8.4}$$

4. SERVICE PROCEDURE

4.1. DO Probe membrane replacement and probe renovation

The probe's membrane should be wiped clean from time to time. **The probe should not be taken apart unless the membrane is damaged or unless, after long use (some years), you cannot calibrate up to the correct value.**

To replace the membrane and/or renovate the probe proceed as follows:

1) Remove the probe, rinse it and unscrew the cap. If it sticks, tap the side of the probe gently with a hammer then try again. Discard the electrolyte, rinse the cap and top part, clean off any brown or black oxide deposits.

Probes can be fitted with membranes either for mg/l or for % saturation measurement. When renovating make sure you use the right anode, membrane and electrolyte.

2) Inspect the anode. If very corroded the anode can be replaced. Check that the nut under the anode is tight before fitting a new anode. Wash the anode in soapy water before use to remove any protective oil. Do not use anodes purchased before 2003 on this probe.

3) Check the cathode and remove any deposits using the plastic abrasive pad supplied with the probe or a little wet or dry emery paper, grade 600. The cathode MUST NOT BE POLISHED.

4) Rinse and dry the top part.

See the drawings overleaf!

5) You can at this stage perform an easy check on the probe. Dry the probe – especially the cathode and area around it - completely, then observe the output signal – the probe should have zero output (less than 0.01 mV when measured at the probe). Contact your distributor if this is not the case.

6) Fill a new (or renovated) cap to the brim with electrolyte – the excess electrolyte helps remove any air bubbles. Locate the flat machined from the thread. Lower the upper part into the cap and turn the cap half a turn to engage the thread. Tilt the probe 15° so that the flat is uppermost and screw the cap onto the top part. Excess electrolyte and air should dribble out at the flat.

The electrolyte is blue!

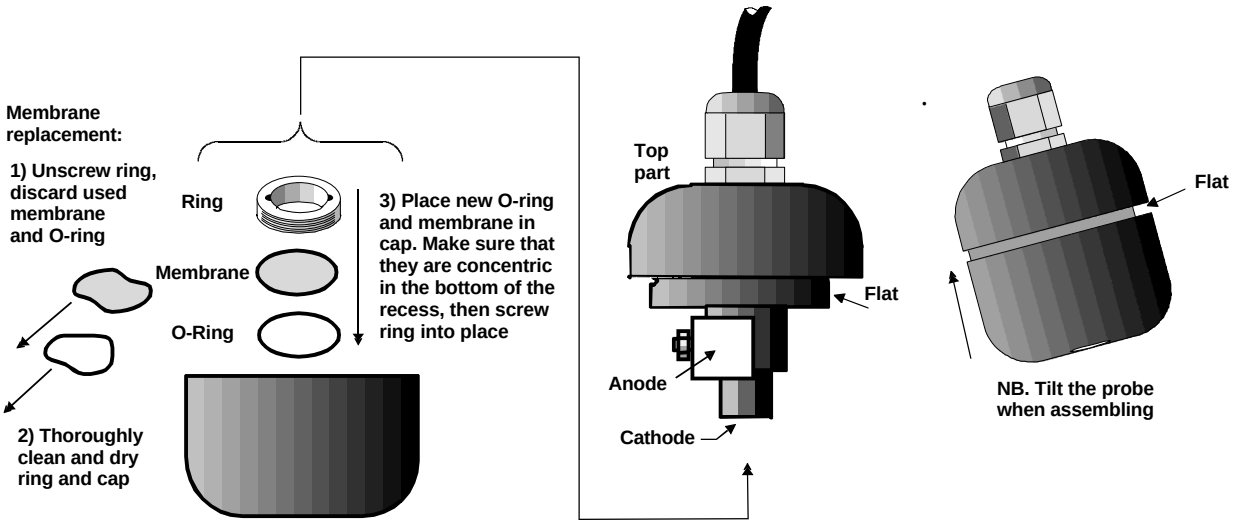
It is important that the probe is filled completely. Shake it close to your ear. If you can hear the electrolyte splashing around inside it open it, re-fill it and try again.

WHEN YOU ARE CERTAIN THAT THE PROBE IS FILLED COMPLETELY TIGHTEN THE CAP **HARD.**

After renovation the probe can be regarded as new. It should be hung up in air to stabilize for at least an hour before calibration. If possible re-calibrate after a day or two.

A new membrane can easily be fitted to the cap - see the drawing overleaf. The membrane must be flat - if it wrinkles remove it and try again with a new one. It is important that all parts are clean and dry. Neither O-ring nor membrane can be used more than once.

A cap must not be re-used without replacing the membrane, as the membrane stretches to fit the cathode, and will not fit perfectly a second time



4.2. Spare Parts

Spare membranes, o-rings and electrolyte for the first few years' use are shipped with the probe, after which you can purchase more. A stock of these parts will enable you to replace a damaged membrane in a few minutes. If desired you can stock a spare probe – you will them be able to replace a probe that is accidentally destroyed, damaged or lost. A spare probe can be kept ready-to-use for years – it should be stored in a cool place. Shake it close to your ear before use – if it needs re-filling with electrolyte it is recommended that you renovate it as described above in section 4.1.

A stock of one or more spare caps will make it easy to renovate probes with damaged or "old" membranes – you can fit new membranes to the "old" caps indoors in the dry ready for next time.

You can also keep one or more spare anodes – type 3 anodes must be washed in soapy water to remove all protective oil before use.

Spare Part Numbers

Sets of 25 membranes with small O-rings:
D10MPPM - For ppm (mg/l) measurements.
D10MSAT - For % sat & % volume measurements.

D10AN3 - Anode for type 3 probes.

D10C3PPM – Type 3 cap with PPM membrane.
D10C3SAT - Type 3 cap with % membrane.

D10PP - Membrane protector.
D10TOOL - Membrane ring removal tool.

D10E30500 - 500 ml type 3 electrolyte.
D10E31L - 1 l type 3 electrolyte.

5. SPECIFICATIONS

5.1 DO Probe

Dimensions:	Diameter = 58 mm, length = 59 mm. Cable length = 5 m (standard)
Weight:	Weight 450 g incl. cable
Principle:	Galvanic cell, self polarising, self temperature-compensating
Output:	2.5 to 5 millivolts per mg/l. Output impedance approx. 1 kiloohm
Operating Conditions:	0 to 40°C, and depths to 100 m. Other on request.

Data subject to change without notice