

SCHOTT®
Instruments

LFOx1400 LFOx1400-ID



Combined Conductivity and Dissolved Oxygen Sensor

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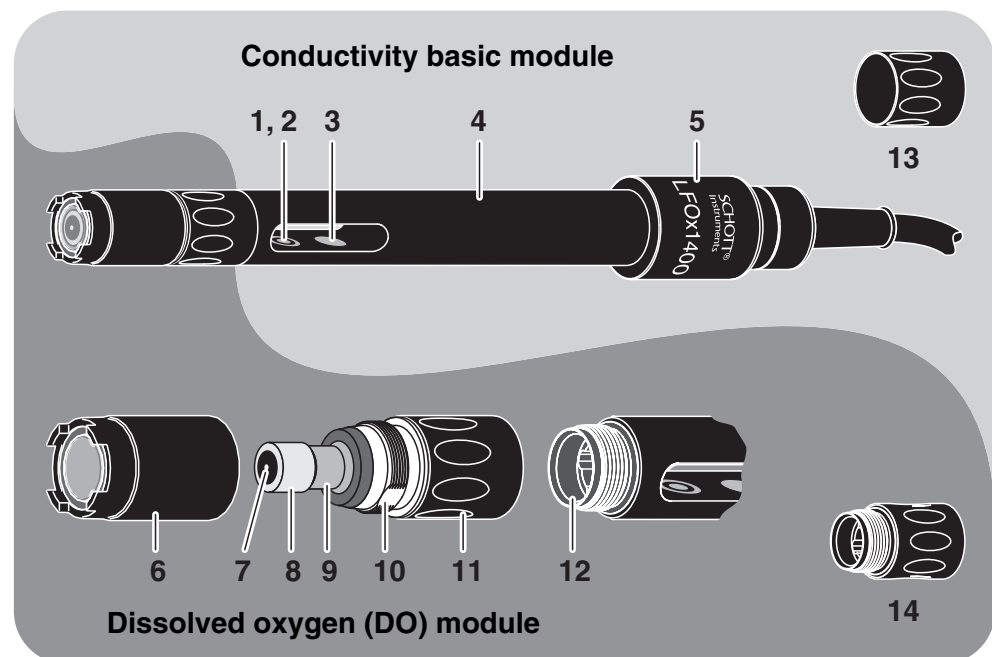
1 Overview

1.1 Structure and function

The LFOx1400(-ID) is a modular sensor for conductivity, dissolved oxygen (DO) and temperature. It consists of two basic components:

- *Conductivity basic module*, according to the quadripole measuring principle, with integrated temperature sensor
- Removable *dissolved oxygen module*, according to the galvanic measuring principle

Structure of the
LFOx1400(-ID)

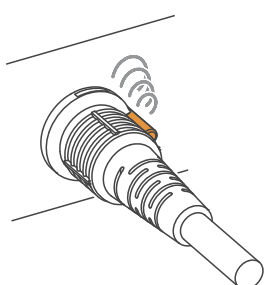


- 1 Voltage electrode (inside, 2x)
- 2 Current electrode (ring, 2x)
- 3 Temperature sensor in a graphite enclosure
- 4 Shaft
- 5 Connection head
- 6 Membrane cap (filled with electrolyte solution)
- 7 Gold working electrode (cathode)
- 8 Insulator
- 9 Lead counter electrode (anode)
- 10 Screw thread base with ventilation area
- 11 Cap nut
- 12 Plug connection
- 13 Closing cap for conductivity basic module
- 14 Closing cap for DO module

The conductivity basic module can be used as an independent conductivity measuring cell. For this purpose, unscrew the DO module and close the open plug connection with a closing cap.

The DO module is connected to the conductivity basic module via a water-tight, three-pole plug connection. The conductivity basic module measures the temperature, which is required for the determination of the DO content. For this reason the DO module only works in conjunction with the conductivity basic module.

Automatic sensor recognition



In the plug connector of the LFOx1400-ID sensor, data is stored for the automatic sensor recognition function. Among other, this data includes the sensor type and series number. Besides, the calibration data is written in the sensor with every calibration procedure. When the sensor is connected, the data is called up by the meter and used for measurement and measured value documentation. The correct data is always used automatically if the sensor is operated with several meters because the data is stored in the sensor.

To be able to use the automatic sensor recognition function, a meter is required that supports the function. More information on the automatic sensor recognition function is given in the operating manual of the meter.

Recommended fields of application

- On site measurements in rivers, lakes and wastewater
- Ground water measurements
- Applications in water laboratories

1.2 Instrument identification

A series number is printed on both LFOx1400(-ID) modules. Keep these numbers ready if you have questions to ask the SI Analytics service department. The series numbers contain the following information:

Conductivity basic module

The number is printed on the shaft.

1	2	3	
0	3	3	6
0	0	1	3

- 1 Manufacturing year 20... (example: 2003)
- 2 Calendar week of manufacturing (CW 36)
- 3 Sequential batch number (0013)

Dissolved oxygen (DO) module

The number is printed on the cap nut.

1	2	3	4
0	3	4	2
A	0	0	7

- 1 Manufacturing year 20... (example: 2003)
- 2 Calendar week of manufacturing (CW 42)
- 3 Sensor type (type A)
- 4 Sequential batch number (007)

2 Safety

This operating manual contains special instructions that must be followed during the operation of the sensor.

Always keep this operating manual in the vicinity of the sensor.

Special user qualifications

The membrane cap of the DO module is filled with a small amount of an alkaline electrolyte solution. All maintenance work that requires dealing with the electrolyte solution must only be carried out by persons who know how to deal with chemicals safely.

General safety instructions

The individual chapters of this operating manual use safety labels like the one below to indicate danger:



Caution

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

3 Commissioning

3.1 Scopes of delivery

3.1.1 Scope of delivery of the LFOx1400(-ID)

- LFOx1400(-ID) combination conductivity and DO sensor, DO module filled with electrolyte solution and ready to use
- 1 closing cap for conductivity basic module
- 1 closing cap for DO module
- 3 exchange membrane caps, Ox923
- Calibration and storage vessel, OxiCal®-CX
- Polishing strip, SF300
- Electrolyte solution, Ox920
- Cleaning solution, Ox921
- Operating manual for LFOx1400(-ID)



Note

The membrane cap that is mounted on the DO sensor for delivery serves mainly as a transport protection. Depending on the duration of the transport and storage period, it may have a shortened operational lifetime. If the measuring system cannot be calibrated (error message on the instrument), please proceed according to section 5.3 DO MODULE: CHANGING THE ELECTROLYTE SOLUTION AND MEMBRANE CAP.

3.1.2 Scope of delivery of the conductivity basic module

- Conductivity basic module
- 1 closing cap, mounted on the conductivity basic module
- Operating manual for LFOx1400(-ID)

3.1.3 Scope of delivery of the DO module

- DO module, filled with electrolyte solution and operable
- 1 closing cap, mounted on the DO module
- 1 exchange membrane cap, Ox923
- Polishing strip, SF300
- Electrolyte solution, Ox920
- Cleaning solution, Ox921
- Operating manual for LFOx1400(-ID)



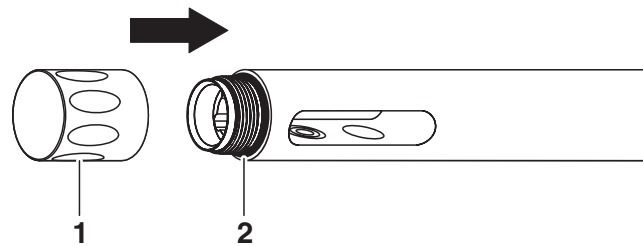
Note

The membrane cap that is mounted on the DO sensor for delivery serves mainly as a transport protection. Depending on the duration of the transport and storage period, it may have a shortened operational lifetime. If the measuring system cannot be calibrated (error message on the instrument), please proceed according to section section 5.3 DO MODULE: CHANGING THE ELECTROLYTE SOLUTION AND MEMBRANE CAP.

3.2 Getting the sensor ready for measuring

3.2.1 Measurements with the conductivity basic module

Make sure that the plug connection is tightly closed by the closing cap. When mounted, the closing cap (1) must be screwed on up to the stop.

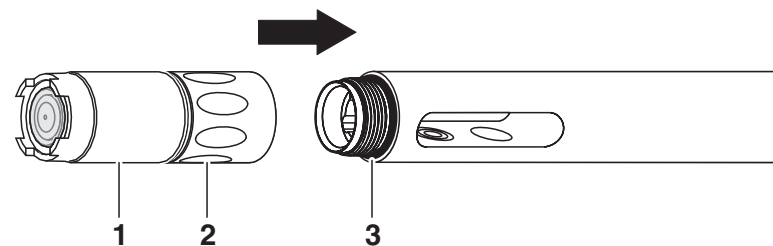


Before screwing on the closing cap, check the following points:

- The sealing (2) must be clean and evenly positioned in the groove.
- The plug connection and the inside of the closing cap must be clean.

3.2.2 Measurements with the combination sensor

Make sure that the DO module and conductivity basic module are screwed together tightly. When mounted, the cap nut of the DO module has to be screwed on up to the stop.



Before screwing on the DO module, check the following points:

- The sealing (3) must be clean and evenly positioned in the groove.
- The plug connection must be dry on both sides.

Screwing on the DO module

Position the DO module (1) on the conductivity basic module and carefully and with slight pressure turn it until the guiding nib on the DO module locks in place in the corresponding groove on the conductivity basic module. Subsequently tighten the cap nut (2) up to the stop. The thread only snatches if the DO module was correctly positioned.

Unscrewing the DO module



Unscrew the cap nut and remove the DO module from the conductivity basic module.

Caution

Inappropriate handling can lead to the release of electrolyte solution. When unscrewing the DO module only turn the cap nut (not the membrane cap!).

3.2.3 Preparing the measuring operation

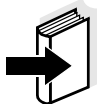
Connect the sensor to the measuring instrument. The sensor is immediately ready to measure. It is not necessary to polarize the DO module.

4 Measuring / Operation

4.1 Calibration

To calibrate for DO measurements, use the OxiCal®-CX calibration and storage vessel. If the A 325/K or A 325/S armoring is used, you have to remove the protective hood and fixing nut of the armoring first.

When determining the cell constant, observe the respective minimum immersion depth with the closing cap or D. O. module screwed on (important: the temperature sensor must be submersed). The minimum immersion depths are given in chapter 7 TECHNICAL DATA.



Note

Please read the course of the calibration in the operating manual of the measuring instrument.

4.2 Measuring

Please always observe the required minimum immersion depth and the minimum approach flow that is important for DO measurements (see chapter 7 TECHNICAL DATA).

Minimum approach flow for DO measurements

The minimum flow can be provided in different ways, e. g.:

- The flow of the water to be measured is sufficient (aeration tank, water pipe, stream)
- Slowly pull the sensor through the water by hand (lake, container), or
- Use a flow aid, e. g. a magnetic stirrer with stirring device or a battery stirrer (see chapter 8 WEAR PARTS AND ACCESSORIES)



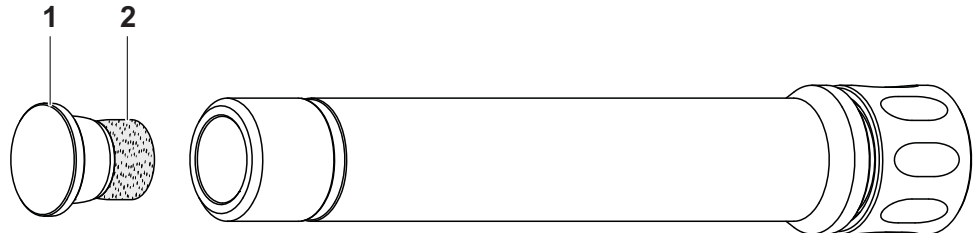
Note

When using the BR 325 battery stirrer, please make sure that the protective pipe already has the groove in the area of the conductivity basic module (from the year of manufacture, 2004).

4.3 Storage

Always store the sensor with the DO module in the calibration vessel at a temperature of 0 to +50 °C. Make sure that the sponge in the calibration vessel is always moist.

Storage in the
calibration vessel,
OxiCal®-CX



Moisten the sponge:

- Remove the cap (1).
- Take out the sponge (2), wet it, then slightly squeeze it out.
- Reinsert the sponge and close the calibration vessel with the cap.

5 Maintenance, cleaning, replacement

5.1 General maintenance instructions

For your safety

Note the following safety instructions when handling electrolyte and cleaning solutions:



Caution

The Ox920 electrolyte solution irritates eyes and skin. When dealing with the Ox920 electrolyte solution, observe the following points:

- During working activities, always wear suitable protective gloves and protective goggles/face shield.
- If it comes into contact with the skin, rinse thoroughly with water and immediately change contaminated clothing.
- If it comes into contact with the eyes, rinse thoroughly with water and consult a doctor.
- Follow the safety datasheet.

**Caution**

The Ox921 cleaning solution irritates eyes and skin. When dealing with the Ox921 cleaning solution, observe the following points:

- During working activities, always wear suitable protective gloves and protective goggles/face shield.
- If it comes into contact with the skin, rinse thoroughly with water and immediately change contaminated clothing.
- If it comes into contact with the eyes, rinse thoroughly with water and consult a doctor.
- Follow the safety datasheet.

**Caution**

Before all maintenance activities, disconnect the sensor from the instrument.

**Note**

Information on how to order wear parts and maintenance means can be found in chapter 8 WEAR PARTS AND ACCESSORIES.

Maintenance activities on the DO module

For better handling, leave the DO module screwed on the conductivity basic module. Thus, you can better immerse the sensor head in the electrolyte or cleaning solution and the plug connection remains protected against damage.

5.2 Outside cleaning

Cleaning agents

Contamination	Cleaning procedure
Lime sediments	Immerse in acetic acid for 1 minute (volume share = 20 %)
Fat/oil	Clean with warm water that contains washing-up liquid

After cleaning, thoroughly rinse with deionized water and recalibrate if necessary.

5.3 DO module: Changing the electrolyte solution and membrane cap



General information

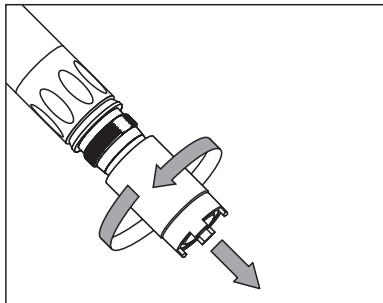
Caution

Before starting to work with the sensor, please note the **GENERAL MAINTENANCE INSTRUCTIONS** on page 34.

SI Analytics delivers the DO module ready to use (see section 3). The electrolyte solution and the membrane cap must only be replaced if:

- a calibration error occurs and the membrane is heavily contaminated
- the membrane is damaged
- the electrolyte solution is exhausted.

Changing the electrolyte solution and membrane cap

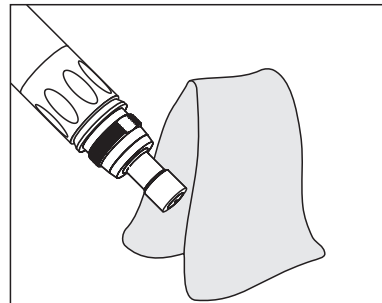


Unscrew the membrane cap.

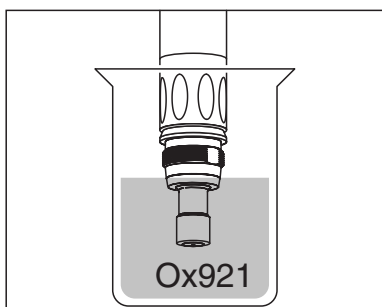
Caution: Electrolyte solution!
For disposal of the membrane cap and electrolyte solution, see section 5.7.



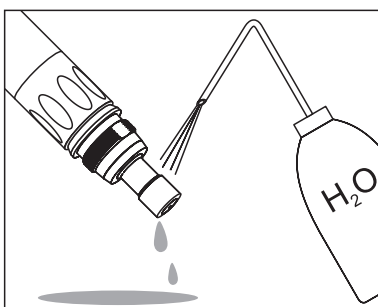
Rinse the sensor head with deionized water.



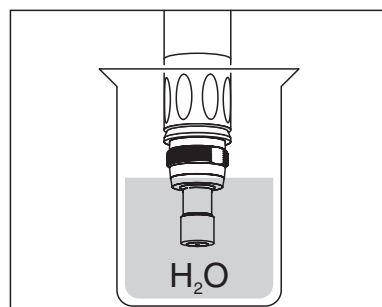
Carefully rub and dry the counter electrode with a lint-free paper towel.



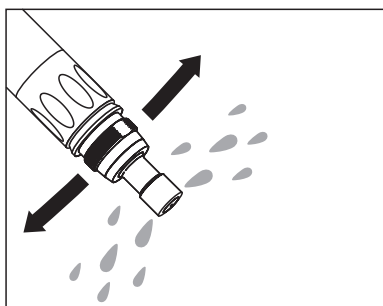
Immerse the sensor head including the counter electrode in Ox921 cleaning solution.
Allow to react for 1 to 3 minutes.



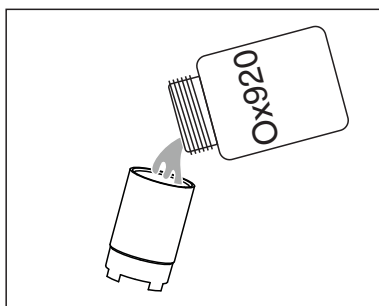
Thoroughly rinse the sensor head with deionized water.



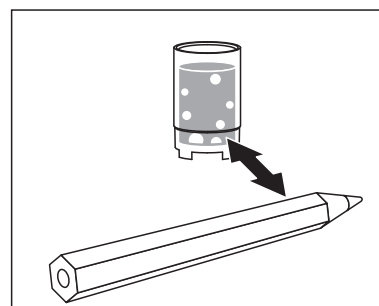
Water the counter electrode in deionized water for at least 10 minutes.



Carefully shake off the drops of water.



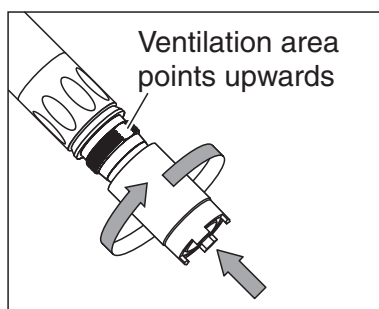
Fill a new membrane cap with Ox920 electrolyte solution.



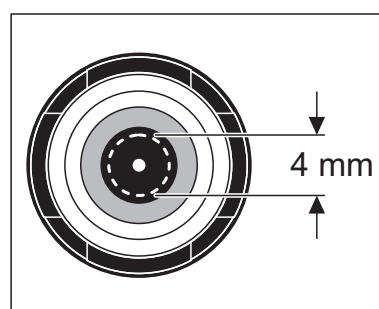
Remove any air bubbles by carefully tapping the membrane cap. Additionally, you can prevent air bubbles by throwing the first filling away and refilling the membrane cap.



Thoroughly rinse the sensor head with electrolyte solution.



Hold the sensor inclined and screw on the membrane cap fingertight using a paper towel. Excess electrolyte solution is forced out of the ventilation area.



Check the filling: Inspect the face surface. No air bubbles may be present within the dashed circle. Air bubbles outside this area do not interfere.



Readiness to measure



Note

For measurements under high pressure the filling must be completely free of air bubbles.

The DO module is ready for operation after approx. 30 to 50 minutes. Subsequently calibrate the sensor for DO measurements.

Note

If you want to measure very low DO concentrations (< 0.5 % saturation), we recommend to let the sensor rest overnight and then calibrate it.

5.4 DO module: Cleaning the electrodes



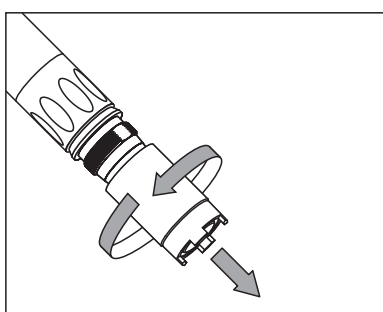
General information

Caution

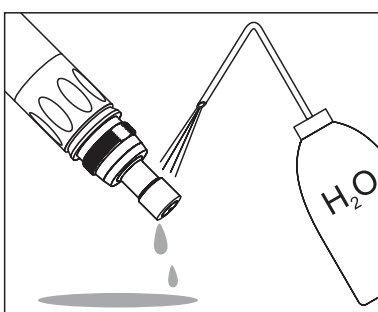
Before starting to work with the sensor, please note the **GENERAL MAINTENANCE INSTRUCTIONS** on page 34.

Cleaning is only required in cases of slopes too small or too large (sensor cannot be calibrated) that cannot be resolved by changing the membrane cap and electrolyte solution.

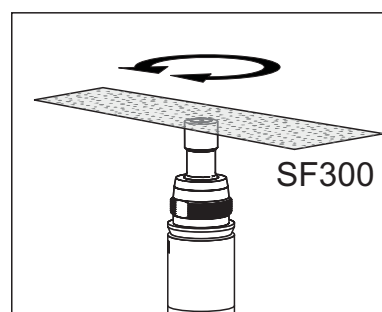
Cleaning the electrodes



Unscrew the membrane cap.
Caution: Electrolyte solution!
For disposal of the membrane cap and electrolyte solution, see section 5.7.

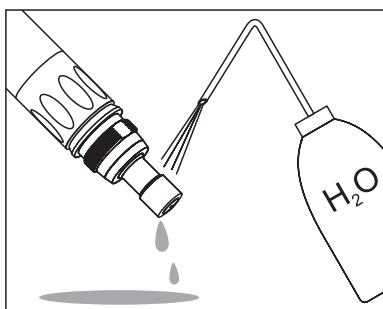


Rinse the sensor head with deionized water.

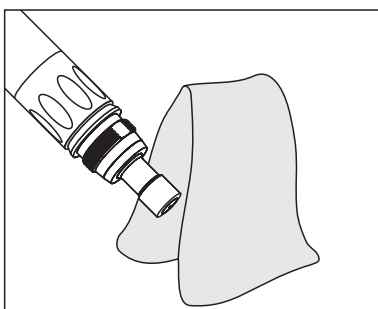


Using the rough side of the **wet** SF300 polishing strip, polish off any contamination from the gold working electrode using light pressure.

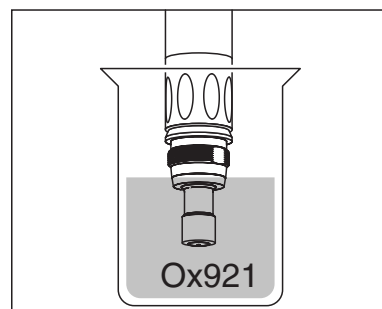
Caution: Do not use any conventional sandpaper or glass-fiber brushes.



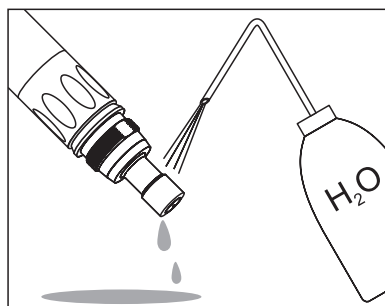
Rinse the sensor head with deionized water.



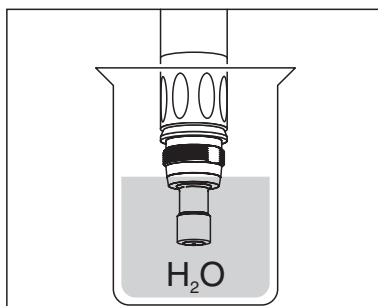
Wipe the counter electrode with a lint-free paper towel and carefully remove any loose white deposits.



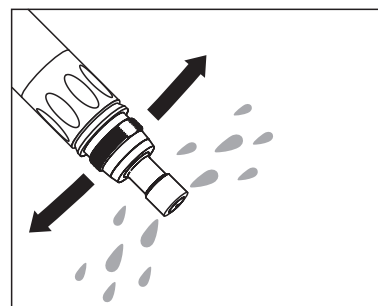
Immerse the sensor head including the counter electrode in Ox921 cleaning solution. Allow to react for 1 to 3 minutes.



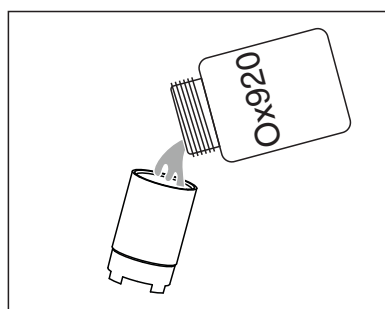
Thoroughly rinse the sensor head with deionized water.



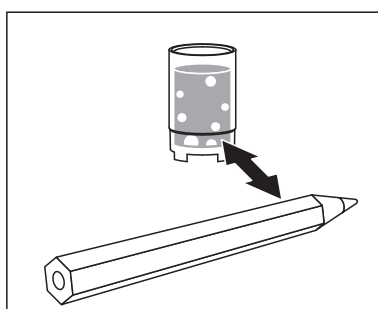
Water the counter electrode in deionized water for at least 10 minutes.



Carefully shake off the drops of water.



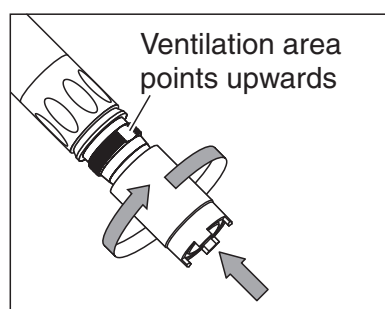
Fill a new membrane cap with Ox920 electrolyte solution.



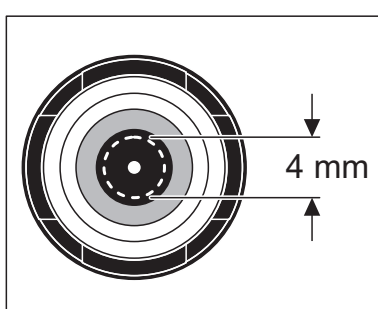
Remove any air bubbles by carefully tapping the membrane cap. Additionally, you can prevent air bubbles by throwing the first filling away and refilling the membrane cap.



Rinse the sensor head with electrolyte solution.



Hold the sensor inclined and screw on the membrane cap fingertight using a paper towel. Excess electrolyte solution is forced out of the ventilation area.



Check the filling:
Inspect the face surface. No air bubbles may be present within the dashed circle. Air bubbles outside this area do not interfere.

**Note**

For measurements under high pressure the filling must be completely free of air bubbles.

Readiness to measure**Note**

If you want to measure very low DO concentrations (< 0.5 % saturation), we recommend to let the sensor rest overnight and then calibrate it.

5.5 Checking the DO module for freedom from zero-current

The DO module is free from zero-current. Checking the module for freedom from zero-current is only necessary in the case of malfunctions that cannot be remedied by exchanging the electrolyte solution and membrane cap or by cleaning the electrodes.

There are two possibilities to check the DO module for freedom from zero-current:

- Measurement in a nitrogen atmosphere (recommended method)
- Measurement in a sodium sulfite solution according to DIN EN 25814/ISO 5814.

**Caution**

If you check the sensor according to DIN EN 25814/ISO 5814, do not leave the sensor in the sodium sulfite solution for more than 2 minutes. Danger of sensor poisoning!

Test criterion

The DO module is OK if the measuring instrument displays < 1 % DO saturation after 2 minutes.

5.6 Aging of the conductivity measuring cell

Normally, the conductivity measuring cell does not age. Special measuring media (e.g. strong acids and lyes, organic solvents) or too high temperatures shorten the operational lifetime considerably or damage the measuring cell. The warranty does not cover cases where such conditions cause failure or mechanical damage.

5.7 Disposal



Caution

The Ox920 electrolyte solution irritates eyes and skin. When dealing with the Ox920 electrolyte solution, observe the following points:

- During working activities, always wear suitable protective gloves and protective goggles/face shield.
- If it comes into contact with the skin, rinse thoroughly with water and immediately change contaminated clothing.
- If it comes into contact with the eyes, rinse thoroughly with water and consult a doctor.
- Follow the safety datasheet.

Conductivity basic module, DO module and membrane cap

For disposal, unscrew the membrane cap from the DO module. Then rinse the entire sensor and the membrane cap with water.

We recommend to dispose of the conductivity basic module and the DO module without membrane cap as electronic waste. The membrane cap may be disposed of with the household refuse.

Electrolyte solution

Disposal according to the safety data sheet.

6 What to do if...

6.1 Error symptoms of DO measurement

Error symptom	Cause	Remedy
The sensor is in the air and the display shows 0.0 mg/l or 0 % O ₂	– No connection between measuring instrument and sensor – Cable defective – No electrolyte in the membrane cap	– Check connection between measuring instrument and sensor – Replace and refill the membrane cap (see section 5.3)
The sensor cannot be calibrated	– Contaminated membrane cap – Electrolyte depleted	– Replace and refill the membrane cap (see section 5.3) Subsequently, wait for 30 to 50 min and recalibrate.
The sensor still cannot be calibrated after changing the electrolyte and membrane cap	– Contaminated electrodes or sensor toxification – membrane cap not screwed on tight enough	– Clean the electrodes (see section 5.4) – Screw membrane cap tighter
Incorrect temperature display	– The temperature sensor of the conductivity basic module was not immersed deep enough in the measuring solution – Temperature sensor defective	– Observe the minimum immersion depth – Return the sensor
Mechanical damage to the sensor		– Return the sensor

6.2 Error symptoms of conductivity measurement

Error symptom	Cause	Remedy
No temperature or conductivity display	– No connection between measuring instrument and sensor – Cable defective	– Check connection between measuring instrument and sensor
Measurement delivers implausible conductivity values	– Incorrect cell constant adjusted at the measuring instrument – Measuring range exceeded – Contamination in the area of the electrodes – Electrodes damaged	– Check / correct the cell constant – Observe the application range – Clean the sensor (see section 5.2). – Return the sensor
Incorrect temperature display	– The temperature sensor was not immersed deep enough in the measuring solution – Temperature sensor defective	– Observe the minimum immersion depth – Return the sensor

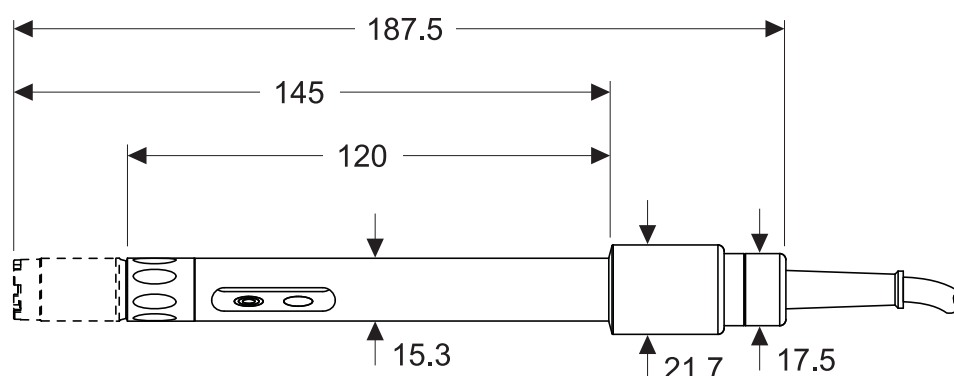
7 Technical data

7.1 Conductivity basic module

General features

Measuring principle	Four-electrode measurement
Cell constant	$0.475 \text{ cm}^{-1} \pm 1.5 \%$
Temperature sensor	integrated NTC 30 (30 k Ω / 25 °C)

Dimensions (in mm)



Weight

approx. 135 g (without DO module, with 1.5 m cable)

Materials

Shaft	Epoxy
– Connection head	POM
– Closing cap	PVC
Plug connection for DO module	PEEK
Conductivity electrodes	Graphite
Thermistor enclosure	Graphite

Connection cable

Lengths	1.5 / 3 / 6 / 10 / 15 / 20 m
Diameter	6 mm
Smallest allowed bend radius	Fixed installation: 50 mm Flexible use: 80 m
Plug type	Socket, 8 pins

Connector for DO module

Plug type	3-pole, watertight plug connection with cap nut, reverse polarity protected, contacts gold-plated
-----------	---

Pressure resistance

Sensor with closed plug connection	IP 68 (3×10^5 Pa or 3 bar)
Cable plug	IP 67 (when plugged in)

The LFOx1400(-ID) meets the requirements according to article 3(3) of the 97/23/EC directive ("Pressure equipment directive").

Measurement conditions

Conductivity measuring range	1 μ S/cm ... 2 S/cm
Temperature range	0 ... 50 °C
Max. allowed overpressure	3×10^5 Pa (3 bar)
Depth of immersion	min. 6 cm (with closing cap) min. 8 cm (with DO module) max. 20 m (depending on the cable length)
Operating position	any
Approach flow	not required

Storage conditions

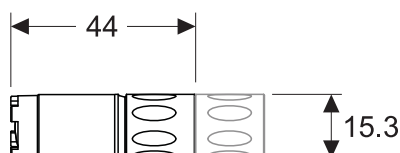
Recommended storing method	in the OxiCal®-CX calibration vessel (moistened) or dry (without DO module)
Storage temperature	0 ... 50 °C

Characteristic data on delivery

Temperature responding behavior	t_{99} (99 % of the final value display after) < 20 s
Precision of the temperature sensor	± 0.3 K

7.2 Dissolved oxygen (DO) module**General features**

Measuring principle	Membrane covered galvanic sensor
Temperature compensation	IMT compensation (calculated by the measuring instrument)

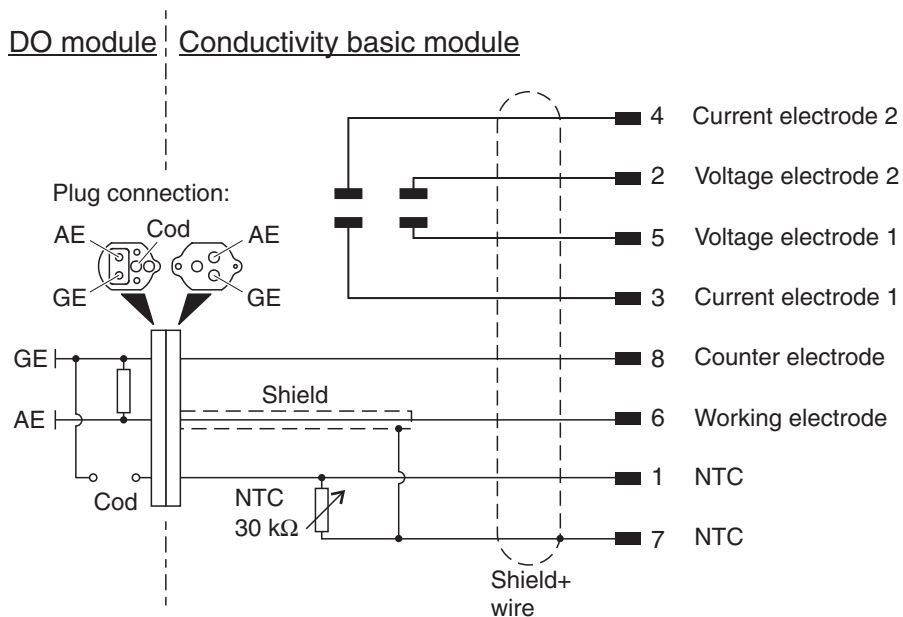
Dimensions (in mm)**Weight**

approx. 20 g (filled with electrolyte)

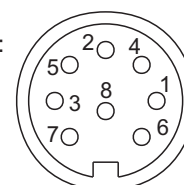
Materials	Working electrode	Gold
	Counter electrode	Lead
	– Membrane cap	POM
	– Cap nut	
	Membrane	FEP, 13 µm
	– Sensor head	Epoxy, PEEK
	– Plug connection	PEEK
	Screw thread base	Stainless steel 1.4571
	Seals	FPM (Viton)
Plug connection	Closing cap	POM
	Plug type	3-pole, watertight plug connection with cap nut, reverse polarity protected, contacts gold-plated
Pressure resistance	Sensor with closed plug connection	IP 68 (3 x 10 ⁵ Pa or 3 bar)
	The DO module meets the requirements according to article 3(3) of the 97/23/EC directive ("Pressure equipment directive").	
Measurement conditions	Measuring ranges at 20 °C	0 ... 50 mg/l DO 0 ... 600 % DO saturation 0 ... 1250 mbar DO partial pressure
	Polarization time	min. 30 ... 50 min after changing the electrolyte, it is not necessary to connect the sensor to the measuring instrument for polarization
	Temperature range	0 ... 50 °C
	Max. allowed overpressure	3 x 10 ⁵ Pa (3 bar)
	Depth of immersion with conductivity basic module	min. 8 cm max. 20 m (depending on the cable length of the conductivity basic module)
	Operating position	any
	Approach flow	> 3 cm/s at 10 % measurement accuracy 10 cm/s at 5 % measurement accuracy 18 cm/s at 1 % measurement accuracy
Storage conditions	Recommended storing method	in the OxiCal [®] -CX calibration vessel (moistened)
	Storage temperature	0 ... 50 °C

**Characteristic data
on delivery**

Zero signal	< 0.1 % of the saturation value
Response time at 20 °C	t_{90} (90 % of the final value display after) < 10 s t_{95} (95 % of the final value display after) < 16 s t_{99} (99 % of the final value display after) < 60 s
Oxygen own consumption at 20 °C	$0.008 \mu\text{g}\cdot\text{h}^{-1} (\text{mg/l})^{-1}$
Drift	approx. 3 % per month in the operating condition
Working life	min. 6 months with one electrolyte filling

Pin assignment

Plug from the front:



8 Wear parts and accessories

Wear parts and maintenance means

Description	Model
Set of exchange membrane caps (3 pieces)	Ox923/3
Electrolyte solution	Ox920
Cleaning solution for lead counter electrode	Ox921
Polishing film	SF300
Accessory kit, comprising: – 3 exchange membrane caps, Ox923 – Polishing strip, SF300 – Electrolyte solution, Ox920 – Cleaning solution, Ox921	OX 925



Note

For further accessories, refer to the SI Analytics catalog or the Internet.

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