



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

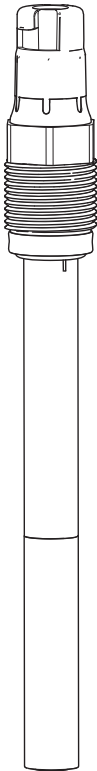


Solutions

Operating Instructions

Oxymax H COS21D

Digital dissolved oxygen sensor



BA402C/07/en/12.07
71066660

Information for the use of this manual

Notes on safety icons and symbols



Warning!

This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.



Caution!

This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.



Note!

This symbol indicates important items of information.

Cross reference symbols



→ 1 This symbol indicates a cross reference to a defined page (e.g. p. 1).



→ 2 This symbol indicates a cross reference to a defined figure (e.g. fig. 2).

1 Safety instructions

1.1 Designated use

The sensor is suitable for continuous measurement of dissolved oxygen in water.

The sensor version determines what the sensor is especially suitable for:

- COS21D-A (measuring range 0.01 to 20 mg/l)
 - Measuring, monitoring and regulating the oxygen content in fermenters
 - Monitoring the oxygen contents in biotechnological systems
- COS21D-B (trace measurement with high CO₂ partial pressure, measuring range 0.001 to 20 mg/l, preferred operational range 0.001 to 2 mg/l)
 - Monitoring inerting units in the food industry
 - Monitoring the residual oxygen contents in carbonated media in the beverage industry
- COS21D-C (trace measurement, measuring range 0.001 to 20 mg/l, preferred operational range 0.001 to 2 mg/l)
 - Trace measurement in industrial applications such as inerting
 - Monitoring residual oxygen contents in boiler feedwater
 - Monitoring, measuring and regulating the oxygen contents in chemical processes



Caution!

The sensor must not be used for measurement in hydrogen loaded media.

The COS21D sensor must be connected to the digital input of the Liquiline transmitter using the CYK10 measuring cable for non-contact, digital data transfer.

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

Please note the following items:

- Installation, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
 - The technical personnel must be authorized for the specified activities by the system operator.
- Electrical connection must only be carried out by a certified electrician.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorized and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.

- Repairs not described in these Operating Instructions may only be carried out at the manufacturer's or by the service organization.

1.3 Operational safety

The sensor has been designed and tested according to the state of the art and left the factory in perfect functioning order.

Relevant regulations and European standards have been met.

As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local prevailing standards and regulations.

1.4 Safety Instructions for Ex versions

The inductive sensor-cable-plug-in system Memosens, consisting of

- oxygen sensor Oxymax H COS21D-*12*1 and
- measuring cable CYK10-G**1

is suitable for the use in explosion-hazardous areas acc. to the type-examination certificate BVS 04 ATEX E 121 X . The corresponding EU declaration of conformity is part of this document.



Caution!

- The certified oxygen sensor Oxymax H COS21D-*12*1 in combination with the measuring cable CYK10-G**1 may only be connected to certified, intrinsically-safe, digital sensor circuits of the transmitter Liquiline M CM42-*G*****. The electrical connection must be carried out in compliance with the wiring diagram.
- Oxygen sensors for use in Ex areas have a special, conductive O-ring. The metallic sensor shaft is electrically connected to the conductive mounting location (e.g. a metallic assembly) by means of the O-ring.
- You must take appropriate measures to connect the assembly or the mounting location to the operational ground in accordance with Ex guidelines.
- The sensors must not be used under electrostatic critical process conditions. Strong vapour or dust streams acting directly on the plug-in system are to be avoided.
- Ex versions of digital sensors with Memosens technology are marked with an orange-red ring on the plug-in head.
- The maximum permissible cable length is 100 m (330 ft).

1.5 Return

If the sensor has to be repaired, please return it *cleaned* to the sales center responsible.

Please use the original packaging, if possible.

Please enclose the completed "Declaration of Hazardous Material and De-Contamination" (copy the second last page of these Operating Instructions) with the packaging and the transportation documents.

No repair without completed declaration!

2 Identification

2.1 Product structure

Application, operational range	
A	Standard 0.01 to 20 mg/l
B	Trace, beverages (CO ₂ compatible) 0.001 to 2 mg/l
C	Trace, power plants 0.001 to 2 mg/l
Shaft length	
1	120 mm (4.72")
Approvals	
1	None
2	ATEX (ATEX II 1G EEx ia IIC T3/T4/T6, COS21D-A* and COS21D-C* only)
3	FM/CSA (COS21D-A* and COS21D-C* only)
Certificates	
1	None
2	EN10204 3.1
Options	
1	None
2	FDA membrane cap

COS21D-						Complete order code
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2.2 Scope of delivery

The following items are included in the delivery:

- Oxygen sensor with transport protection cap for membrane protection
- Electrolyte, 1 bottle, 25 ml (0.85 fl.oz.)
- Pipette for filling with electrolyte
- Operating Instructions, English

If you have any questions, please contact your supplier or your sales center responsible.

2.3 Certificates and approvals

2.3.1 Ex approval

Versions COS21D-A*2*1, COS21D-C*2*1

ATEX II 1G EEx ia IIC T3/T4/T6

Versions COS21D-3*1**

FM/CSA

Class I, Div. 1, Groups A, B, C, D, T3/T4/T6










Class I, Zone 0, AEx ia IIC, T3/T4/T6

Notified body

EXAM BBG Prüf- und Zertifizier GmbH

Bochum

EG 1295/07/a3

EG-Konformitätserklärung EC Declaration of Conformity CE Déclaration de Conformité

Endress+Hauser Conducta
Gesellschaft für Mess- und Regeltechnik mbH+Co. KG
Dieselstrasse 24, D-70839 Gerlingen

erklärt in alleiniger Verantwortung, dass das Produkt
declares in sole responsibility that the product
déclare sous sa seule responsabilité que le produit

Oxymax H COS21D-*12*1

mit Messkabel / with measuring cable / avec câble de mesure

CYK10-G1**

EG-Baumusterprüfbescheinigung: BVS 04 ATEX E 121 X
EC type examination certificate:
Certificat de l'examen CE de type :

mit den Vorschriften folgender Europäischen Richtlinien übereinstimmt:
is in conformity with the regulations of the following European Directives:
est conforme aux prescriptions et directives Européennes suivantes:

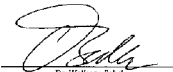
94/9/EG (Geräte zur Verwendung in explosionsgefährdeten Bereichen)
(Equipment for use in potentially explosive atmospheres)
(Appareils et systèmes de protection en atmosphère explosive)


Angewandte harmonisierte Normen oder normative Dokumente:
Applied harmonized standards or normative documents:
Normes harmonisées ou documents normatifs appliqués:
EN 50014:1997 / A1:1999 / A2:1999
EN 50020:2002
EN 60284:1999

Benannte Stelle für QS-Überwachung:
Notified body for QA control:
Organisme notifié pour l'assurance qualité :

EXAM BBG Prüf- und Zertifizier GmbH
Kettnummer / Identification number /
numéro d'identification (0156)

Gerlingen, 12. Dezember 2006


 Dr. Wolfgang Bahrdt
 Geschäftsführer / Managing Director / P.D.G.

Endress+Hauser 
 People for Process Automation

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Fig. 1: EC declaration of conformity

2.3.2 FDA conformity

The manufacturer declares the FDA compliance of the materials used.
You can download the certificates from the product page (www.endress.com).

Product	FDA certificate for
COS21D-**1*2	Membrane, O-rings
COS21D-**1*1	when using membrane kits 71003199, 71023226
Membrane kits 71003199, 71023226	Membrane, O-rings

3 Installation

3.1 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
Inform the supplier about damage to the packaging. Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
Inform the supplier about damage to the delivery contents. Keep the damaged products until the matter has been settled.
- Check that the scope of delivery is complete and agrees with your order and the shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your sales center responsible.

3.2 Installation conditions

3.2.1 Angle of installation

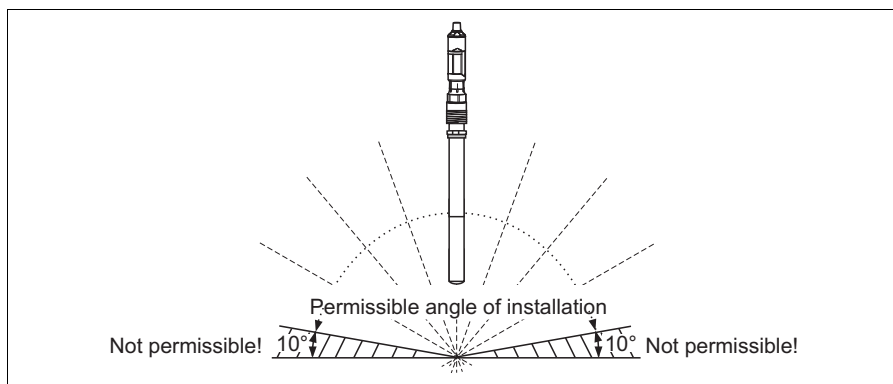


Fig. 2: Permitted angle of installation

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The sensor must be installed with an angle of inclination of at least 10 ° to the horizontal in an assembly, support or a suitable process connection. Other angles are not permissible. Do **not** install the sensor overhead.



Note!

Make sure you comply with the instructions for installing sensors. You will find them in the Operating Instructions for the assembly used.

3.2.2 Mounting location

- Select the installation location so that there is easy access for later calibration.
- Make sure that upright posts and assemblies are secured safely and vibration-free.
- For immersed operation in an activated sludge basin, select an installation location which produces a typical oxygen concentration.

3.3 Installation instructions

3.3.1 Measuring system

A complete measuring system comprises:

- The digital oxygen sensor Oxymax H COS21D
- A transmitter, e.g. Liquiline M CM42
- An appropriate measuring cable, e.g. CYK10
- Optional: an assembly, e.g. fixed installation assembly CPA442, flow assembly CPA240 or retractable assembly CPA475

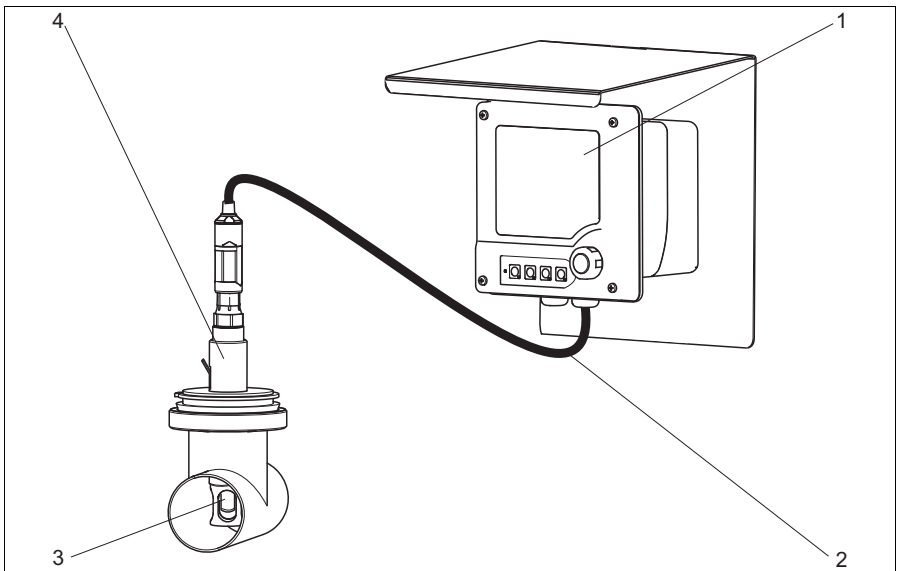


Fig. 3: Example of a measuring system

- 1 *Liquiline M CM42*
- 2 *Measuring cable CYK10*
- 3 *Digital oxygen sensor Oxymax H COS21D*
- 4 *Fixed installation assembly CPA442*

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3.3.2 Installing a measuring point

For a complete installation of a measuring point, proceed as follows:

1. Install a retractable or a flow assembly (if used) into the process.
2. Connect the water supply to the rinse connections (if you use an assembly with cleaning function).
3. Install and connect the oxygen sensor.



Caution!

- **Do not install the sensor suspended from the cable.**
- Screw the sensor into the assembly so that the cable is not twisted.
- Mounting or dismantling the sensor: hold the sensor body, only turn the threaded plug-in head while screwing the sensor in or out of the assembly. Otherwise you could unscrew the sensor's membrane cap. It will remain in the assembly resp. in the process then.
- Avoid exerting excessive tensile force on the cable (e.g. from jerky pulling).
- Select the installation location so that there is easy access for later calibration.



Warning!

When using metallic assemblies and installation equipment, comply with national grounding regulations.

3.4 Installation examples

3.4.1 Fixed installation (CPA442)

The CPA442 fixed installation assembly allows a sensor to be easily adapted to almost any process connections from Ingold nozzles to Varivent or Triclamp connections.

This type of installation is very suitable for tanks and larger pipes. The sensor achieves a defined immersion depth in the medium in an easy manner →  3.

3.4.2 Flow assembly (CPA240)

The CPA240 flow assembly offers up to three installation slots for sensors with a shaft diameter of 12 mm (0.47"), a shaft length of 120 mm (4.72") and a process connection Pg 13.5.

It is very suitable for use in pipes or at hose connections.

During trace measurement in particular, ensure the assembly is completely vented to avoid measuring errors.

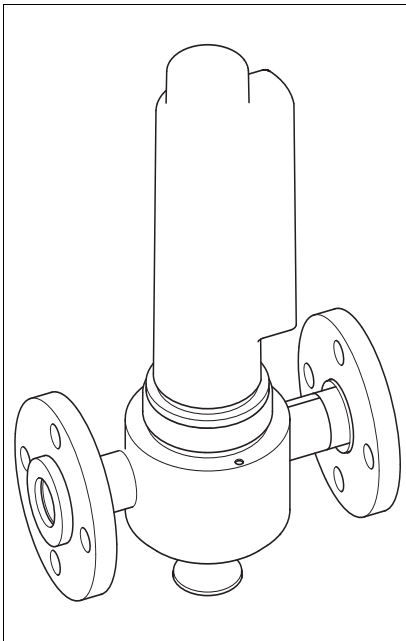


Fig. 4: CPA240 flow assembly with protective hood

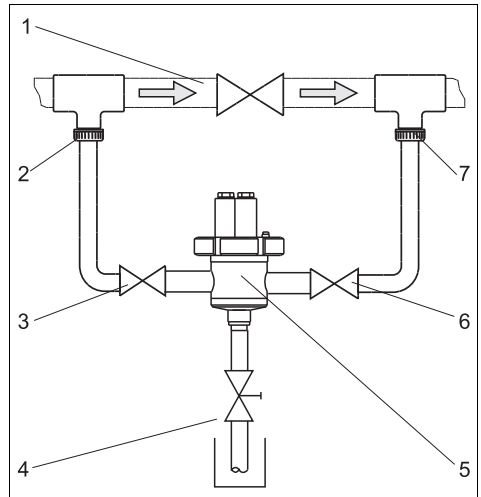


Fig. 5: Bypass installation

- 1 Main line
- 2 Medium removal
- 3, 6 Manually actuated or solenoid valves
- 4 Sampling
- 5 Flow assembly with installed sensor
- 7 Medium return

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3.4.3 Retractable assembly (CPA475 or CPA450)

The assembly is designed for installation on tanks and pipes. Suitable nozzles must be available for this.

Install the assembly at places with constant flow. The minimum pipe diameter is DN 80.

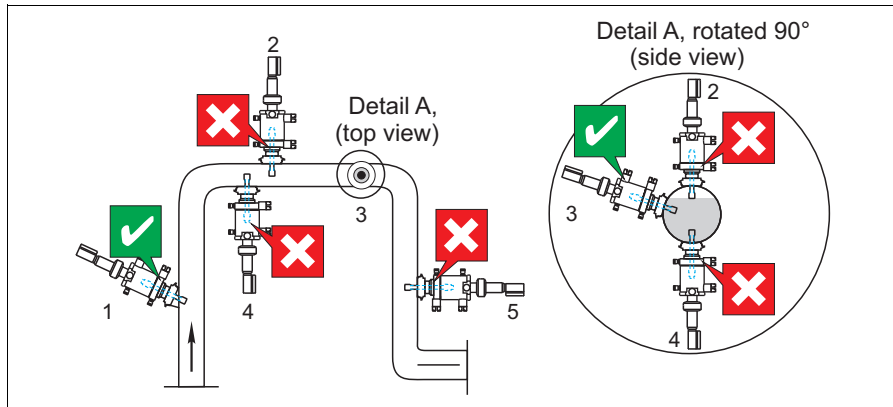


Fig. 6: Suitable and unsuitable installation positions with a retractable assembly

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- 1 Ascending pipe, best position
- 2 Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming
- 3 Horizontal pipe, installation with permissible installation angle (acc. to sensor version)
- 4 Overhead installation, impermissible due to missing electrolyte contact of the sensor electrodes
- 5 Down pipe, impermissible



Note!

Do not install the assembly at places where air cushions or foam bubbles can form. Measuring errors can occur, if:

- the sensor is not immersed into the medium
- suspended particles are settled on the sensor membrane
- the sensor is installed overhead.

3.5 Post-installation check

- Sensor and cable undamaged?
- Cap undamaged?
- Compliance with permissible sensor installation position?
- Is the sensor installed in an assembly and is not suspended from the cable?
- Avoid moisture by rain by putting the protective cap on the assembly?

4 Wiring



Warning!

- The electrical connection must only be carried out by a certified electrician.
- Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- Ensure that there is no voltage at the power cable before beginning the connection work.

4.1 Sensor version for Ex applications

4.1.1 Quick wiring guide

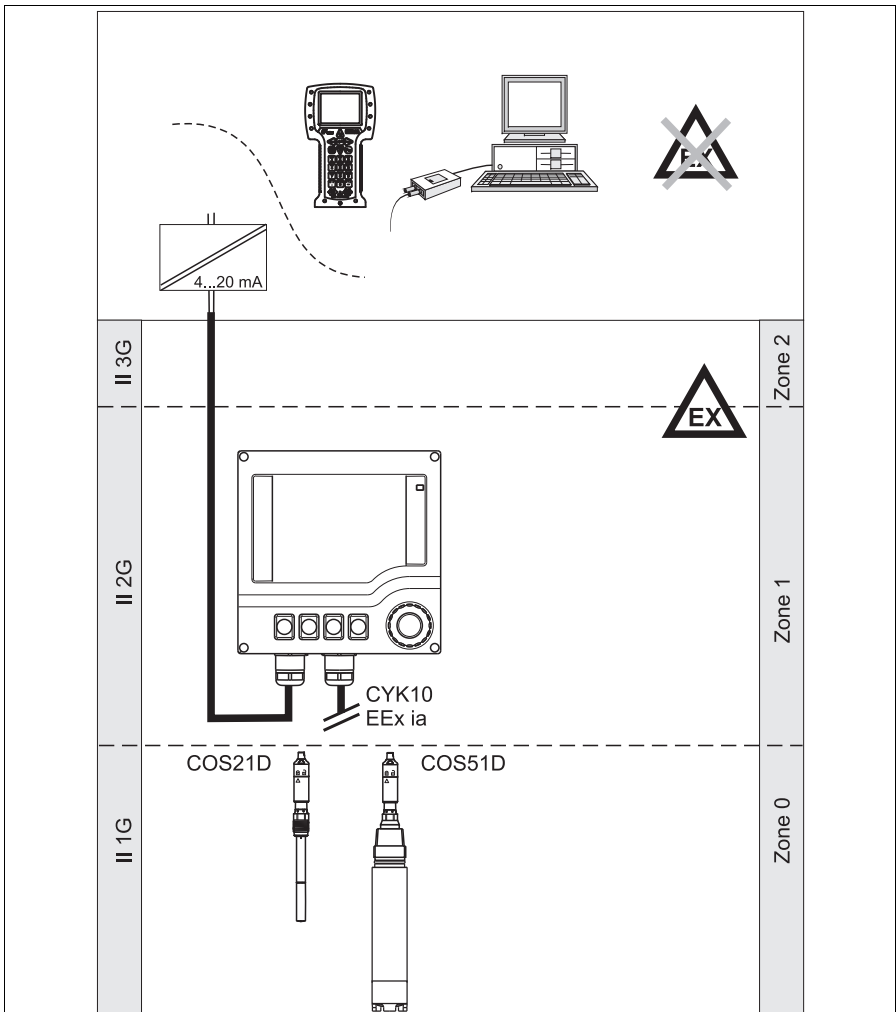


Fig. 7: Connection in the Ex area

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4.1.2 Temperature classes



Note!

If the ambient temperatures indicated are observed, no temperatures which are impermissible for the temperature class in question will occur at the sensor.

	Temperature class		
	T3	T4	T6
Ambient temperature T_a	-5 ... +135 °C	-5 ... +120 °C	-5 ... +70 °C
Reference temperature T_{ref}	+25 °C		

4.2 Direct connection to Liquiline M

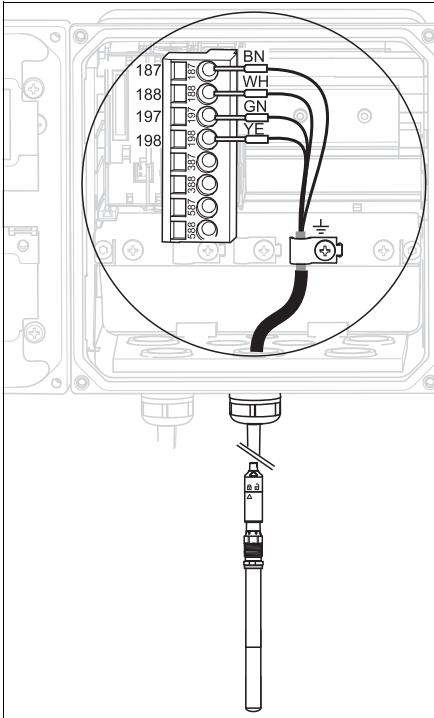


Fig. 8: View in device (sensor module)

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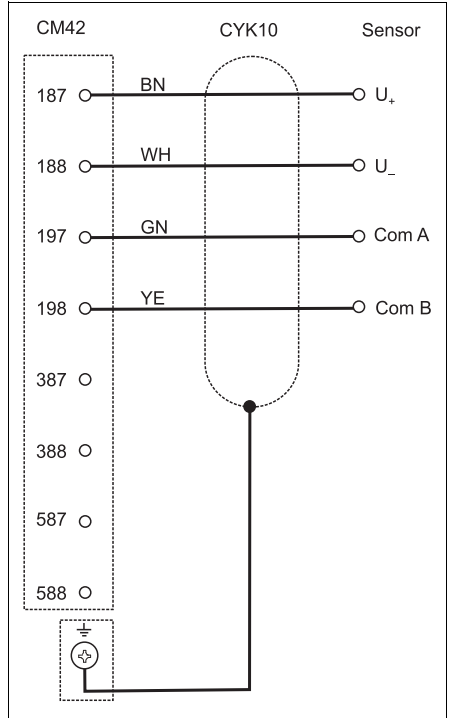


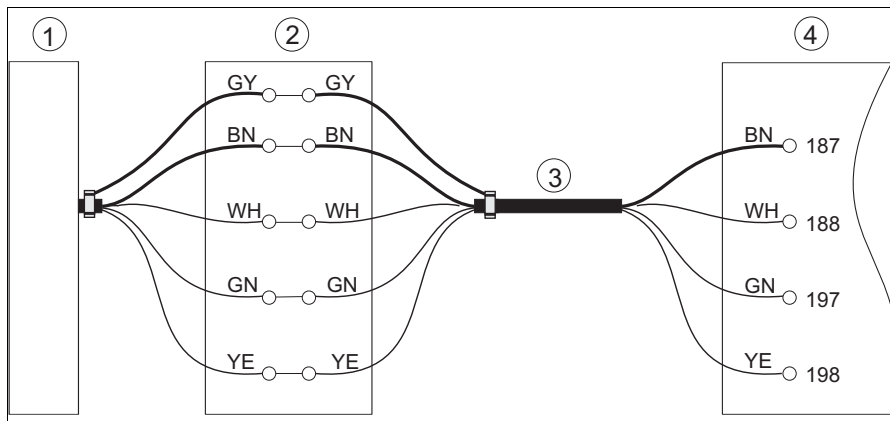
Fig. 9: Wiring diagram

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4.3 Connection via junction box

To extend the sensor cable, the connection has to take place using a junction box RM (→ Accessories). The extension to the transmitter is established by means of the CYK81 special measuring cable.

The maximum permissible cable length is 100 m (328 ft).



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Fig. 10: Wiring diagram with junction box RM

- 1 Sensor
- 2 Junction box
- 3 Extension cable
- 4 Transmitter

4.4 Post-connection check

Instrument status and specifications	Remarks
Are the sensor, assembly, junction box or cable damaged?	Visual inspection
Electrical connection	Remarks
Are the installed cables strain-relieved and not twisted ?	
Long enough length of cable core stripped and correct in terminal?	Check seating (pull slightly)
Are all the screws terminals properly tightened ?	Tighten
Are all the cable entries installed, tightened and sealed ?	For cable entries lateral: cable loops downwards for water to be able to drip off.
Are all the cable entries installed downwards or lateral ?	

5 Function

5.1 Sensor design

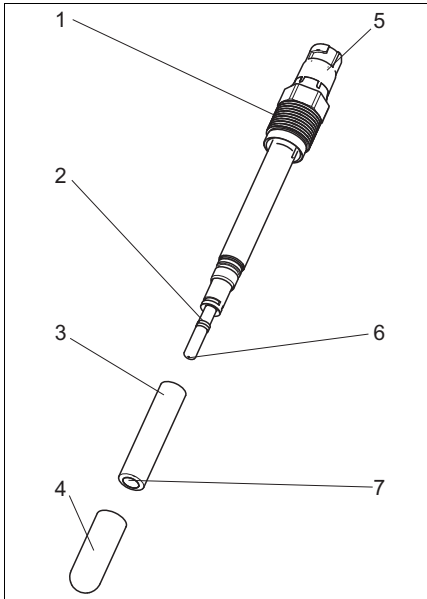


Fig. 11: Design

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- 1 Threaded connection Pg 13.5
- 2 Anode
- 3 Membrane cap
- 4 Protective cap
- 5 Memosens plug-in head
- 6 Cathode
- 7 Membrane

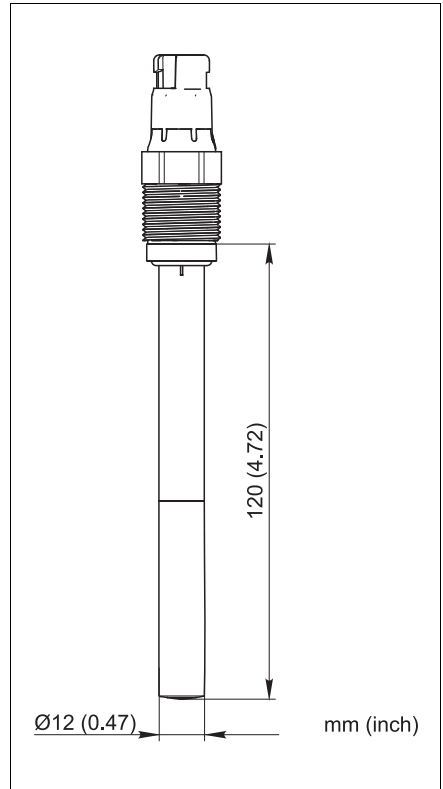


Fig. 12: Dimensions

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5.2 Measuring principle

5.2.1 Polarization

When the sensor is connected to the transmitter, a fixed external voltage is applied between the cathode and anode. The resulting polarization current is indicated on the display of the transmitter. The current starts high but then drops over time. The sensor can only be calibrated when the display is stable.

Reference value for practically complete polarization of a sensor that was in storage for an extended period beforehand:

- COS21D-A/C: 2 hours
- COS21D-B: 12 hours

After this time, measurements close to the determination limit make sense.

The polarization time needed is shorter for sensors which were in operation shortly beforehand.

5.2.2 Membrane cap

The oxygen dissolved in the medium is conveyed to the membrane by the incoming flow. The membrane is only permeable for dissolved gases. Other substances dissolved in the liquid phase e.g. ionic substances, will not penetrate through the membrane. Therefore, medium conductivity has no impact on the measuring signal.

The sensor is supplied with a standard membrane cap which can be used for all common applications.

The membrane cap is pretensioned at the factory and can be installed directly.

There are also special membrane cap kits as an option (→ Accessories):

- FDA-Kit: membrane materials are in conformity with FDA
- SIP/CIP-Kit: membrane material is specially designed for the high demands of frequent SIP/CIP processes



Note!

The electrolytes in the membrane caps are specific to the sensor versions and must **not** be mixed together!

5.2.3 Amperometric principle

The oxygen molecules diffused through the membrane are reduced to hydroxide ions (OH^-) at the cathode. Silver is oxidized to silver ions (Ag^+) at the anode (this forms a silver halogenide layer).

A current flows due to the electron donation at the cathode and the electron acceptance at the anode. Under constant conditions, this flow is proportional to the oxygen content of the medium.

This current is converted in the transmitter and indicated on the display as an oxygen concentration in mg/l , as a saturation index in % SAT or as an oxygen partial pressure in hPa.

5.2.4 Memosens technology

The sensor is connected to the cable connection (CYK10) without contact. The power and data are transferred inductively

Once connected to the transmitter, the data saved in the sensor are read digitally. You can call up these data using the corresponding DIAG menu.

Data that digital sensors save include the following:

- Manufacturer data
 - Serial number
 - Order code

- Date of manufacture
- Calibration data
 - Calibration date
 - Calibration values
 - Number of calibrations
 - Serial number of the transmitter used to perform the last calibration
- Operational data
 - Date of commissioning
 - Hours of operation under extreme conditions
 - Number of sterilizations
 - Data for sensor monitoring.

5.3 Calibration

Calibration is a means of adapting the transmitter to the characteristic values of the sensor.

Normally, sensor calibration is seldom necessary. It is necessary after:

- First commissioning
- Replacing a membrane or electrolyte
- Cleaning the cathode
- Long breaks in operation without power supply

Within the framework of system monitoring and supervision, for example, the calibration can also be cyclically monitored (at typical time intervals, depending on operating experience) or renewed.

5.3.1 Types of calibration

You can carry out single-point or two-point calibration for the sensor.

In most applications, single-point calibration suffices in the presence of oxygen (=calibration of measured value at air).

The additional calibration of the zero point (two-point calibration) improves the precision of the measurement results in the trace range. Calibrate the zero point with nitrogen (minimum 99.995%) or with water free from oxygen, for example. In doing so, make sure the measured value has settled correctly (20 to 30 minutes) to avoid incorrect measurements in the trace range at a later stage.

Types of calibration:

- Slope:
 - Air (saturated with water vapor, e.g. near the water surface)
 - Air-saturated water
 - Variable air (entering the current relative humidity and the absolute air pressure)
 - Data entry
- Zero point:
 - Zero point calibration (nitrogen or water free from oxygen)
 - Data entry

- Reference:
 - Offset
 - Slope



Note!

The following section **only** describes the calibration in air (saturated with water vapor) as the easiest method of calibration and therefore the recommended method.

However, this type of calibration is only possible if the air temperature is $\geq -5\text{ °C}$ (23 °F).

5.3.2 Calibration in air

1. Remove the sensor from the medium.
2. Clean the outside of the sensor with a damp cloth.
Then dry the sensor membrane e.g. by using a tissue.
3. If the sensor is removed from a closed pressure system with a process pressure greater than atmospheric pressure:
 - Open the membrane cap to equilibrate the pressure and clean the cap if necessary.
 - Replace the electrolyte filling and close the membrane cap again.
 - Wait for the polarization time to end.
4. Then wait while the sensor adjusts to the temperature of the ambient air. This takes about 20 minutes. Check that the sensor is not in direct sunlight during this time.
5. If the measured value display on the transmitter is stable, carry out the calibration in accordance with the Operating Instructions of the transmitter.
6. Place the sensor in the medium again.



Note!

Make sure you comply with the instructions for calibration in the Operating Instructions of the transmitter.

5.3.3 Calculation example for the calibration value

As a check, you can calculate the expected calibration value (transmitter display) as shown in the following example (salinity is 0).

1. Determine:
 - The ambient temperature for the sensor (air temperature for "air" calibration method, water temperature for "air-saturated water" calibration type)
 - the altitude above sea level
 - the current air pressure (=rel. air pressure to sea level) at the time of calibration. (If undeterminable, use 1013 hPa (407 inH₂O) for an approximate calculation.)
2. Define:
 - the saturation value **S** acc. to the first table
 - the factor **K** acc. to the second table

T [°C (°F)]	S [mg/l=ppm]	T [°C (°F)]	S [mg/l=ppm]	T [°C (°F)]	S [mg/l=ppm]	T [°C (°F)]	S [mg/l=ppm]
0 (32)	14.64	11 (52)	10.99	21 (70)	8.90	31 (88)	7.42
1 (34)	14.23	12 (54)	10.75	22 (72)	8.73	32 (90)	7.30
2 (36)	13.83	13 (55)	10.51	23 (73)	8.57	33 (91)	7.18
3 (37)	13.45	14 (57)	10.28	24 (75)	8.41	34 (93)	7.06
4 (39)	13.09	15 (59)	10.06	25 (77)	8.25	35 (95)	6.94
5 (41)	12.75	16 (61)	9.85	26 (79)	8.11	36 (97)	6.83
6 (43)	12.42	17 (63)	9.64	27 (81)	7.96	37 (99)	6.72
7 (45)	12.11	18 (64)	9.45	28 (82)	7.82	38 (100)	6.61
8 (46)	11.81	19 (66)	9.26	29 (84)	7.69	39 (102)	6.51
9 (48)	11.53	20 (68)	9.08	30 (86)	7.55	40 (104)	6.41
10 (50)	11.25						

Altitude [m (ft)]	K	Altitude [m / ft]	K	Altitude [m / ft]	K	Altitude [m / ft]	K
0	1.000	550 (1800)	0.938	1050 (3450)	0.885	1550 (5090)	0.834
50 (160)	0.994	600 (1980)	0.932	1100 (3610)	0.879	1600 (5250)	0.830
100 (330)	0.988	650 (2130)	0.927	1150 (3770)	0.874	1650 (5410)	0.825
150 (490)	0.982	700 (2300)	0.922	1200 (3940)	0.869	1700 (5580)	0.820
200 (660)	0.977	750 (2460)	0.916	1250 (4100)	0.864	1750 (5740)	0.815
250 (820)	0.971	800 (2620)	0.911	1300 (4270)	0.859	1800 (5910)	0.810
300 (980)	0.966	850 (2790)	0.905	1350 (4430)	0.854	1850 (6070)	0.805
350 (1150)	0.960	900 (2950)	0.900	1400 (4600)	0.849	1900 (6230)	0.801
400 (1320)	0.954	950 (3120)	0.895	1450 (4760)	0.844	1950 (6400)	0.796
450 (1480)	0.949	1000 (3300)	0.890	1500 (4920)	0.839	2000 (6560)	0.792
500 (1650)	0.943						

3. Calculate the factor L:

$$L = \frac{\text{relative air pressure during calibration}}{1013 \text{ hPa}}$$

4. Calculate the calibration value **C**:

$$C = S \cdot K \cdot L$$

Example

- Air calibration at 18°C (64 °F), altitude 500 m (1650 ft) above sea level, air pressure 1009 hPa (405 inH₂O)
- S = 9.45 mg/l, K = 0.943, L = 0.996

Calibration value C = 8.88 mg/l.



Note!

You do not need factor K from the table if your device returns the absolute air pressure L_{abs} (location-dependent air pressure) as the measured value.

Thus, the formula for calculation is: $C = S \cdot L_{abs}$.

6 Commissioning

6.1 Function check

Before first commissioning, check if:

- the sensor is correctly installed
- the electrical connection is correct.

If using an assembly with automatic cleaning, check the correct water connection at the assembly rinse connection.



Warning!

Danger of medium leaking off

Before applying compressed air to an assembly with cleaning facility, make sure the connections are correctly fitted. Otherwise, the assembly may not be insert into the process.

6.2 Polarization

The sensor was tested in the factory for perfect functionality and is supplied ready for operation.

To prepare for calibration, proceed as follows:

1. Remove the sensor protective cap.
2. Place the externally dry sensor in atmospheric air. The air should be saturated with water vapour. Therefore, install the sensor as close to the water surface as possible. When calibrating the sensor membrane, make sure the membrane remains dry. Therefore, avoid any direct contact with the water surface.

3. Connect the sensor to the transmitter and switch on the transmitter.
4. Switch-on the transmitter.
If you connect the sensor to the transmitter, polarization is automatically performed after switching on the transmitter.
5. Wait for the polarization time to end.



Caution!

- When you remove the sensor from the medium, protect the sensor from strong sunlight.
- Make sure you comply with the instructions for commissioning and calibration in the Operating Instructions of the transmitter.

6.3 Calibration

Calibrate the sensor (air calibration) immediately after the polarization time has elapsed.

The calibration intervals depend heavily on:

- The application and
- The installation position of the sensor.

The following methods help you determine how long the calibration intervals should be:

1. Check the sensor one month after its being put into operation by taking it out of the fluid, drying it and then measuring the oxygen saturation index at air after 10 minutes.
Decide using the results:
 - a. If the measured value is not at $100 \pm 2 \% \text{SAT}$, you have to calibrate the sensor.
 - b. Otherwise, double the length of time to the next inspection.
2. Proceed as per Point 1 after two, four and/or eight months. In this way, you can determine the optimum calibration interval for your sensor.



Note!

Be sure to calibrate the sensor at least once a year.

7 Maintenance

Maintenance work must be carried out at regular intervals. To ensure that it is carried out, we recommend you enter the maintenance dates into an operations logbook or in an operations calendar in advance.

The maintenance cycle primarily depends on:

- the system
- the installation conditions and
- the medium in which measurement is taking place.

The following activities must be carried out:

- Cleaning the sensor

- (In particular when the membrane is soiled)
- If necessary, replacing wear and tear materials:
 - sealing ring
 - electrolyte
 - membrane cap
 - Check the measuring function:
 1. Remove the sensor from the medium.
 2. Clean and dry the membrane.
 3. After about 10 minutes, measure the oxygen saturation index in air (without recalibration).
 4. The measured value should be near to 100 ± 2 % SAT.
 - Recalibration.
(if desired or required)

7.1 Cleaning

The measurement can be corrupted by sensor fouling or malfunction, e.g.:

- Coatings on the sensor membrane
→ cause longer response times and a reduced slope under certain circumstances.
- Soiling or poisoning of the electrolyte
→ causes longer response times and false measurement.

To ensure reliable measurement, the sensor must be cleaned at regular intervals. The frequency and intensity of the cleaning operation depend on the measuring medium.

7.1.1 Cleaning the sensor surface

Clean the sensor:

- before every calibration
- at regular intervals during operation as necessary
- before returning it for repairs.

Depending on the type of soiling, proceed as follows:

Type of soiling	Cleaning
Salt deposits	Immerse the sensor in drinking water or in 1-5% hydrochloric acid for a few minutes. Afterwards, rinse it with copious amounts of water.
Dirt particles on the sensor body (not cap!)	Clean the sensor body mechanically with water and a suitable brush.
Dirt particles on the membrane cap or the membrane	Clean with water and a soft sponge.



Caution!

After cleaning, rinse the sensor with copious amounts of clean water.

7.1.2 Cleaning the cathode



Caution!

COS21D-B:

Do not clean the cathode mechanically! Polishing the cathode may cause functional errors or total failure of the sensor.

COS21D-A und COS21D-C:

Clean coated cathodes with a polishing sheet (included in membrane kits).

1. Water the polishing sheet.
2. Take the polishing sheet into your palm.
3. Polish the cathode in an eccentric movement for several seconds.

7.2 Replacing wear and tear materials

Parts of the sensor will suffer wear and tear during operation.

Suitable action can restore normal operating functionality. This action includes:

Action	Cause
Replacing the sealing ring	visual damage to the sealing ring
Replacing the electrolyte	unstable or implausible measuring signal or electrolyte soiling
Replacing the membrane cap	uncleanable membrane, damaged membrane (hole or overstretch)



Warning!

Before beginning replacing, switch off the power supply at the transmitter.

7.2.1 Replacing the sealing ring

Replacing the sealing ring is only necessary when it is visibly damaged. For replacement, use only original sealing rings.

7.2.2 Replacing the electrolyte

The electrolyte is slowly used up during measuring. The cause of this is electrochemical substance reactions. No substance reactions occur in the de-energized state and the electrolyte is not used up.

The electrolyte life is shortened by diffused, dissolved gases such as H_2S , NH_3 or high concentrations of CO_2 .

The theoretical service life of an electrolyte filling for use in air-saturated drinking water at 20 °C (68 °F) is as follows:

- COS21D-A: 100 weeks
- COS21D-B/C: 20 weeks

**Warning!**

Risk of acid burns!

The electrolyte is very caustic. You must follow the appropriate occupational safety regulations. Always wear protective gloves and goggles with handling electrolytes.

To replace the electrolyte, proceed as follows:

1. Remove the membrane cap.
2. Replace the electrolyte and, if necessary, the membrane cap.
3. Place the membrane cap back on the sensor and screw the cap closed to the stop.
4. Reset the electrolyte replacement counter (Liquiline calibration menu, "Electrolyte replacement").

7.2.3 Replacing the membrane cap

Removing the old membrane cap

1. Remove the sensor from the medium.
2. Clean the outside of the sensor.
3. Unscrew the membrane cap.
4. If necessary, clean the cathode or replace the sealing ring if it is damaged.
5. Rinse the electrode holder with drinking water.

Installing the new membrane cap

1. Make sure that there are no dirt particles on the sealing surface.
2. Using the pipette supplied, fill approx. 1.5 ml (0.05 fl.oz.) of electrolyte into the membrane cap.
3. Hold the sensor body **straight** and carefully screw the membrane cap onto it **until the stop**.
4. Reset the membrane cap counter and the electrolyte counter (Liquiline calibration menu, "Cap replacement").

**Note!**

After replacing the membrane cap, polarize and recalibrate the sensor. Then insert the sensor into the medium and check that no alarm is displayed on the transmitter.

8 Accessories

8.1 Connection accessories

Junction box RM

- For cable extension (e.g. for Memosens sensors or CUS31/CUS41)
- 5 terminals
- Cable entries: 2 x Pg 13.5
- Material: PC
- Ingress protection: IP 65 (≅ NEMA 4X)
- Order no.: 51500832

CYK10 Memosens data cable

- For digital sensors with Memosens technology
- Ordering according to product structure, see Technical Information (TI376C/07/en)

CYK81 measuring cable

- Non-terminated measuring cable for extension of sensor cables of e.g. Memosens sensors, CUS31/CUS41
- 2 wires, twisted pair with shield and PVC-sheath (2 x 2 x 0.5 mm² + shield)
- Sold by the meter, order no. 51502543

8.2 Installation accessories

Flowfit P CPA240

- pH/redox flow assembly for processes with a high level of requirements
- Technical Information TI179C/07/en

Cleanfit H CPA475

- Retractable assembly for installation in tanks and pipework under sterile conditions
- Technical Information TI240C/07/en

Unifit H CPA442

- Installation assembly for food, biotechnology and pharmaceuticals, with EHEDG and 3A certificate
- Technical Information TI306C/07/en

Cleanfit W CPA450

- Manual retractable assembly for installing 120 mm sensors in tanks and pipework
- Technical Information TI183C/07/en

8.3 Measurement

Liquiline M CM42

- Modular two-wire transmitter for Ex and non-Ex areas
- Hart®, PROFIBUS or FOUNDATION Fieldbus available
- Ordering acc. to product structure, Technical Information TI381C/07/en

9 Trouble-shooting

9.1 Trouble-shooting instructions

If any of the following problems occur, test the measuring device as indicated.

Problem	Check	Remedial action
No display, no sensor reaction	Mains voltage to the transmitter?	Connect mains voltage.
	Sensor connected correctly?	Set up correct connection.
	Medium flow available?	Create flow.
	Coating on the membrane?	Clean the sensor.
	Electrolyte in the measuring chamber?	Fill with electrolyte or replace electrolyte.
Displayed value too high	Polarization complete?	Wait until polarization time ends.
	Sensor calibrated?	Recalibrate
	Temperature display clearly too low?	Check sensor, if necessary send sensor in for repair.
	Membrane visibly stretched?	Replace membrane cap.
	Electrolyte soiled?	Replace electrolyte.
	Open sensor. Dry electrodes. Transmitter display now at 0?	Check electrical connection. If the problem still occurs, send the sensor in.
Displayed value too low	Sensor calibrated?	Recalibrate
	Medium flow available?	Create flow.
	Displayesd temperature clearly too high?	Check sensor, if necessary send sensor in for repair.
	Coating on the membrane?	Clean membrane or replace membrane cap.
	Electrolyte soiled?	Replace electrolyte.
Strong deviations in displayed value	Membrane visibly stretched?	Replace membrane cap.
	Open sensor. Dry electrodes transmitter display now at 0?	Check electrical connection. If the problem still occurs, send the sensor in.



Note!

Make sure you comply with the instructions for troubleshooting in the Operating Instructions of the transmitter. If necessary, carry out a test of the transmitter.

9.2 Spare parts and consumable material

Electrolyte solutions

- For COS21D-A:
 - order no. 51505873

- For COS21D-B:
 - order no. 51518701
- For COS21D-C:
 - order no. 51518703

Membrane kits

- Membrane kit Standard, COS21/COS21D:
 - O-rings
 - membrane: silicon rubber
 - order no. 51505874
- Membrane kit Standard, COS21/COS21D, EN10204:
 - O-rings
 - membrane: silicon rubber
 - order no. 51516339
- Membrane kit CIP, COS21/COS21D:
 - O-rings: Viton[®]
 - membrane: silicon rubber
 - order no. 51518699
- Membrane kit CIP, COS21/COS21D, EN10204:
 - O-rings: Viton[®]
 - membrane: silicon rubber
 - order no. 71023225
- Membrane kit FDA, COS21/COS21D:
 - O-rings
 - membrane: FDA certified material
 - order no. 71003199
- Membrane kit FDA, COS21/COS21D, EN10204:
 - O-rings
 - membrane: FDA certified material
 - order no. 71023226

Scope of delivery (all kits):

- 3 Membrane caps
- 1 O-ring (process seal, Viton[®], none-Ex)
- 1 O-ring (sensor, EPDM)



Note!

The electrolytes in the membrane caps are specific to the sensor versions and must **not** be mixed together!

Process seal for Ex applications

- 3 pieces
- Viton[®] (not FDA conform)
- order no. 71023212

9.3 Return

If the sensor has to be repaired, please return it *cleaned* to the sales center responsible.

Please use the original packaging, if possible.

Please enclose the completed "Declaration of Hazardous Material and De-Contamination" (copy the second last page of these Operating Instructions) with the packaging and the transportation documents.

No repair without completed declaration!

9.4 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.

Please observe local regulations.

10 Technical data

10.1 Input

Measured variable Dissolved oxygen [mg/l, % SAT, hPa]
 Temperature [° C, ° F]

Measuring range	Measuring range	Recommended operational range
COS21D-A	0.01 to 20 mg/l 0 to 200 %SAT 0 to 400 hPa	0.01 to 20 mg/l 0 to 200 %SAT 0 to 400 hPa
COS21D-B	0.001 to 20 mg/l 0 to 200 %SAT	0.001 to 2 mg/l 0 to 20 %SAT
COS21D-C	0 to 400 hPa	0 to 40 hPa

10.2 Environment

Storage temperature -10 to +60 °C (10 to 140 °F) at 95% relative air humidity,
 not condensing

 Caution!

Danger of drying out

Only store the sensor with the electrode protection cap (water filled).

Ambient temperature	-5 to +135 °C (23 to 175 °F)
Ingress protection	IP 68 (10 m (33 ft) water column at 25 °C (77 °F) during 45 days, 1 mol/l KCl)

10.3 Process

Process temperature	<ul style="list-style-type: none"> ■ COS21D-A and COS21D-C: -5 to 135 °C (23 to 275 °F) ■ COS21D-B: -5 to 100 °C (23 to 212 °F)
----------------------------	---

Process pressure	<ul style="list-style-type: none"> ■ COS21D-A: 0 to 4 bar (0 to 58 psi) ■ COS21D-B and COS21D-C: 0 to 12 bar (0 to 174 psi)
-------------------------	---

10.4 Performance characteristics

Response time	From air to nitrogen at 25 °C (77 °F)
	<ul style="list-style-type: none"> ■ t_{90} : < 30 s ■ t_{98} : < 60 s

Reference operating conditions	Reference temperature:	25 °C (77 °F)
	Reference pressure:	1013 hPa (15 psi)
	Reference application:	Municipal wastewater treatment

Current value at air	<ul style="list-style-type: none"> ■ COS21D-A: 60 nA (40 to 80 nA) ■ COS21D-B and COS 21D-C: 300 nA (180 to 500 nA)
-----------------------------	---

Zero current	< 0.1 % of the current in air
---------------------	-------------------------------

Measured value resolution	<ul style="list-style-type: none"> ■ COS21D-A: 10 µg/l (10 ppb) ■ COS21D-B and COS21D-C: 1 µg/l (1 ppb)
----------------------------------	---

Maximum measured error	±1 % of measured value ¹⁾
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Repeatability	±1 % of measured value	
----------------------	------------------------	--

Long-term drift	Zero-point drift:	< 0.1 % per week at 30 °C (86 °F)
	Measuring range drift:	< 0.1 % per week at 30 °C (86 °F) ¹⁾

1) under constant conditions each

Influence of medium pressure	Pressure compensation not necessary
-------------------------------------	-------------------------------------

Polarization time	<ul style="list-style-type: none"> ■ COS21D-A and COS21D-C: < 60 minutes ■ COS21D-B: < 12 hours
--------------------------	---

Oxygen depletion (intrinsic consumption)	■ COS21D-A: Approx. 20 ng/h in air at 25 °C (77 °F)
	■ COS21D-B and COS21D-C: Approx. 100 ng/h in air at 25 °C (77 °F)

10.5 Mechanical construction

Weight	0.2 kg (0.44 lbs)
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Materials	Sensor shaft:	Stainless steel 1.4435 (AISI 316L)
	Electrode combination:	Silver / Platinum
	O-rings:	Viton® (FDA certified, original delivery) EPDM (depending on membrane kit)
	Process sealing of ATEX/FM/CSA versions:	Viton® (not FDA conform)
	Membrane	
	COS21D-****2: all other versions:	FDA certified material Silicone rubber

Process connection	Thread Pg 13.5
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Electrolyte	<ul style="list-style-type: none"> ■ COS21D-A and COS21D-C: Alkaline electrolyte ■ COS21D-B: Phosphoric acid electrolyte
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1) In accordance with IEC 746-1 at nominal operating conditions

Index

A

Accessories	
Assemblies	27
For connection	27
Measurement	27
Ambient temperature range	31
Amperometric principle	18
Angle of installation	8

C

Calibration	23
Calculating the calibration value	20
General	19
In air	20
Types of calibration	19
Checking	
Connection	16
Function	22
Installation	12
Cleaning	
Cathode	25
Sensor	24
Sensor surface	24
Commissioning	4, 22
Connection	
Direct connection	15
Current value at air	31

D

Designated use	4
Disposal	30

E

EC Declaration of conformity	6
Electrical connection	
Via junction box	16
Electrolyte	32
Environment	30
Errors	28
Ex approval	6

F

FDA conformity	7
Flow operation	11

I

Icons	2
Immersion operation	11
Incoming acceptance	8
Ingress protection	31
Input	30
Installation	4, 8–9
Angle of	8
Check	12
Examples	11
Flow operation	11
Immersion operation	11
Location	9
Measuring point	10
Retractable assembly	12
Intrinsic consumption	32

L

Long-term drift	32
-----------------	----

M

Maintenance	23
Materials	32
Maximum measured error	31
Measured value resolution	31
Measuring point	10
Measuring principle	17
Measuring system	9
Mechanical construction	32
Medium pressure	32
Membrane cap	18
Memosens	18
Mounting location	9

N

Notified body	6
---------------	---

O

Operation	4
Operational safety	5
Ordering information	6
Oxygen depletion	32

P

Performance characteristics	31
-----------------------------	----

Polarization	17, 22
Polarization time	32
Process	31
Process connection	32
Process pressure	31
Process temperature	31
Product structure	6

R

Reference operating conditions	31
Repeatability	32
Replacing	
Electrolyte	25
Membrane cap	26
Sealing ring	25
Wear and tear materials	25
Response time	31
Retractable assembly	12
Return	5, 30

S

Safety icons	2
Scope of delivery	6
Sealing ring	25
Sensor	
Measuring principle	17
Replacing wear and tear materials	25
Sensor design	17
Spare parts	28
Storage	8
Storage temperature	30
Symbols	2

T

Technical data	30
Environment	30
Input	30
Mechanical construction	32
Performance characteristics	31
Process	31
Transport	8
Types of calibration	19

U

Use	4
-----	---

W

Weight	32
--------	----

Z

Zero current	31
--------------	----

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