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Operating Instructions
Memosens COS81E

Hygienic, optical sensor with Memosens 2.0 technology for the measurement of oxygen

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

1.1 Safety information

Structure of information	Meaning
DANGER **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **will** result in a fatal or serious injury.
WARNING **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **can** result in a fatal or serious injury.
CAUTION **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** If necessary, Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols used

- Additional information, tips
- Permitted
- Recommended
- Forbidden or not recommended
- Reference to device documentation
- Reference to page
- Reference to graphic
- Result of a step

1.2.1 Symbols on the device

- Reference to device documentation
- Minimum immersion depth
- Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

1.3 Supplementary documentation

The following manuals which complement these Operating Instructions can be found on the product pages on the Internet:
- Technical Information for the relevant sensor
- Operating Instructions for the transmitter used
- Operating Instructions for the cable used

In addition to these Operating Instructions, an XA with "Safety instructions for electrical apparatus in the hazardous area" is also included with sensors for use in the hazardous area.

- Please follow instructions on use in the hazardous area carefully.

2 Basic safety instructions

2.1 Requirements for the personnel

- Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may be performed only by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- Faults at the measuring point may only be rectified by authorized and specially trained personnel.

Repairs not described in the Operating Instructions provided must be carried out only directly at the manufacturer's site or by the service organization.

2.2 Intended use

The sensor is designed for continuous measurement of dissolved oxygen in water and aqueous solutions, and also for continuous measurement of oxygen in gases.

The sensor is particularly suitable for:
- Monitoring inertization equipment in the food industry
- Monitoring, measuring and regulating the oxygen content in chemical processes
- Monitoring of fermentation processes

NOTICE

Halogen-containing solvents, ketones and toluene

Halogen-containing solvents (dichloromethane, chloroform), ketones (e.g. acetone, pentanone) and toluene have a cross-sensitive effect and result in decreased measured values or, at worst, in the complete failure of the sensor!

▶ Use the sensor only in media that are free from halogens, ketones and toluene.

For non-contact digital data transmission, the sensor must be connected to the digital input of the transmitter for Memosens sensors using the CYK10 measuring cable.

Use of the device for any purpose other than that described, poses a threat to the safety of people and of the entire measuring system and is therefore not permitted.

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

2.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:
- Installation guidelines
- Local standards and regulations
- Regulations for explosion protection

Electromagnetic compatibility
- The product has been tested for electromagnetic compatibility in accordance with the applicable international standards for industrial applications.
- The electromagnetic compatibility indicated applies only to a product that has been connected in accordance with these Operating Instructions.

2.4 Operational safety

Before commissioning the entire measuring point:

1. Verify that all connections are correct.
2. Ensure that electrical cables and hose connections are undamaged.
3. Do not operate damaged products, and protect them against unintentional operation.
4. Label damaged products as defective.

During operation:

- If faults cannot be rectified:
  products must be taken out of service and protected against unintentional operation.

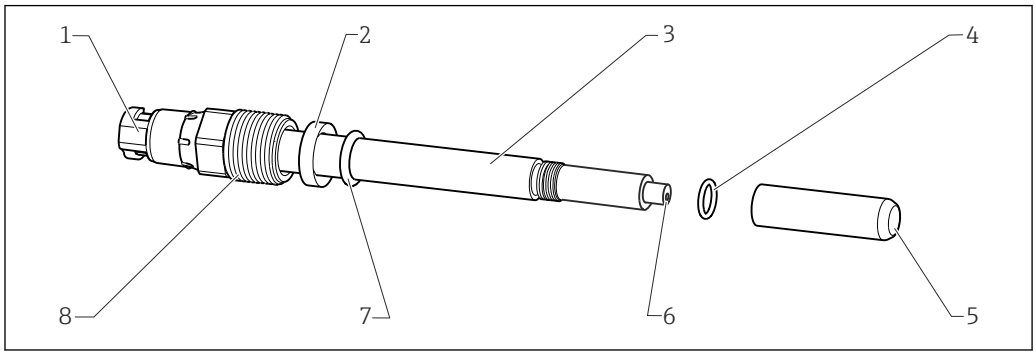
2.5 Product safety

2.5.1 State of the art

The product is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. The relevant regulations and international standards have been observed.

3 Product description

3.1 Product design



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1 *Memosens COS81E*

1	*Memosens plug-in head with optics assembly*	*5*	*Spot cap*
2	*Thrust collar*	*6*	*Optical waveguide with temperature sensor*
3	*Sensor shaft*	*7*	*Process seal 10.77 x 2.62 mm*
4	*O-ring sensor shaft*	*8*	*Process connection Pg 13.5*

The suitability of the selected materials for use in the process must be assessed during the product configuration.

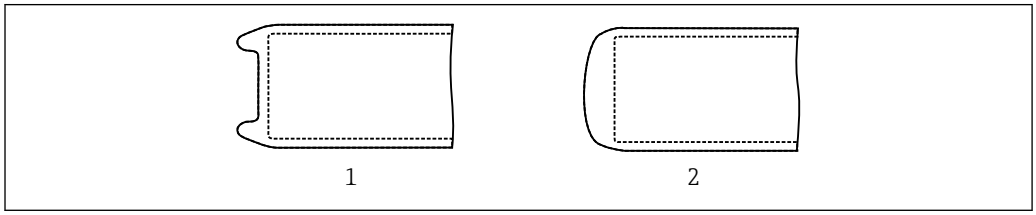
Process conditions that go beyond the resistance range of the materials may shorten the operating life of the materials and make maintenance necessary.

3.1.1 Spot cap

The oxygen dissolved in the medium is diffused to the luminescence layer of the spot cap. A suitable flow is not required, as no oxygen is consumed during measurement. However, flow improves the speed at which the measuring system reacts and ensures a more representative measured value compared to a measurement in a static medium.

The spot is permeable for dissolved gases only. Other substances dissolved in the liquid phase, such as ionic substances, will not penetrate through the membrane. Therefore, medium conductivity has no impact on the measuring signal.

The sensor's spot cap can have either a u-shaped or c-shaped design.



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2 *Design of spot cap*

1 u-shaped
2 c-shaped

3.2 Measuring principle

3.2.1 Optical measuring principle

Sensor structure
Oxygen-sensitive molecules (marker molecules) are integrated into the optically active layer (luminescence layer).
The luminescence layer, an optical insulating layer and a cover layer are applied on top of one another on the carrier. The cover layer is in direct contact with the medium.
The sensor optics are directed at the rear of the carrier and therefore at the luminescence layer.

Measurement process (principle of luminescence quenching)

If the sensor is immersed in the medium, an equilibrium is very quickly established between the oxygen partial pressure in both the medium and the luminescence layer.

1. The sensor optics send orange light pulses to the luminescence layer.
2. The marker molecules "respond" (luminesce) with dark-red light pulses.
   ↳ The decay time and intensity of the response signals are directly dependent on the oxygen contents and oxygen partial pressure.

If the medium is free from oxygen, the response signals are long and very intense.

If the medium is free from oxygen, the decay time is long and the signal is very intense.

Any oxygen molecules present mask the marker molecules. As a result, the decay time is shorter and the signals are less intense.

Measurement result

- The sensor calculates the measurement result on the basis of the signal intensity and decay time using the Stern-Volmer equation.

The air pressure can be either set statically or entered via an additional sensor. The medium temperature is automatically recorded in the sensor. Both values are taken into consideration in the calculation of the oxygen concentration.

The sensor provides measured values for temperature and partial pressure as well as a raw measured value. This value corresponds to the luminescence decay time and is approx. 14 µs in air and approx. 56 µs in oxygen-free media.

For optimum measurement results

1. During calibration, enter the current air pressure at the transmitter.
2. If the calibration is not performed at **Air 100% rh**:
   Enter the current humidity.
3. In the case of media with high salinity:
   Enter the salinity.
4. For measurements in the units %Vol or %SAT:
   Also enter the current operating pressure in the measuring mode.

Observe the documentation of the transmitter used:
- Operating Instructions for Memosens: BA01245C
  For all transmitters, analyzers and samplers in the Liquiline CM44x/P/R, Liquiline System CA80XX and Liquistation CSFxx product families
- Operating Instructions for Liquiline CM42, BA00381C and BA00382C
- Operating Instructions for Liquiline Mobile CML18: BA02002C
- Operating Instructions for Liquiline Compact CM82: BA01845C
- Operating Instructions for Liquiline Compact CM72: BA01797C

3.3 Stabilization time

The measuring method used by the sensor is temperature-dependent. For this reason, the temperature of the sensor must be adapted to the medium temperature during commissioning. Reliable measured values can be obtained once a stable temperature value has been reached.

The temperature usually adapts very quickly in aqueous media. Temperature adaptation can take several minutes in gaseous media.

3.4 Memosens technology

Sensors with Memosens protocol have an integrated electronics unit that stores calibration data and other information. Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the measured value and for Heartbeat Technology functions.

► Call up the sensor data via the corresponding DIAG menu.

Digital sensors can store measuring system data in the sensor. These include the following:
- Manufacturer data
- Serial number
- Order code
- Date of manufacture
- Digital sensor label
- Calibration data of the last eight calibrations including factory calibration with calibration date and calibration values
- Serial number of the transmitter used to perform the last calibration
- Possibility to reset to factory calibration
- In the case of sensors with replaceable measuring elements, the number of calibrations per measuring element and for the entire sensor
- Application data
- Temperature application range
- Date of first commissioning
- Hours of operation under extreme conditions
- Number of sterilizations and CIP cycles (with hygienic sensors)

All Memosens 2.0 E sensors offer these advantages with the latest Liquiline transmitter software. All Memosens 2.0 sensors are backward-compatible with previous software versions and offer the usual Memosens benefits of the D generation.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

1. Verify that the packaging is undamaged.
   ↳ Notify the supplier of any damage to the packaging.
   Keep the damaged packaging until the issue has been resolved.
2. Verify that the contents are undamaged.
   ↳ Notify the supplier of any damage to the delivery contents.
   Keep the damaged goods until the issue has been resolved.
3. Check that the delivery is complete and nothing is missing.
   ↳ Compare the shipping documents with your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture.
   ↳ The original packaging offers the best protection.
   Make sure to comply with the permitted ambient conditions.

If you have any questions, please contact your supplier or your local Sales Center.

4.2 Product identification

4.2.1 Identifying the product

Product page

www.endress.com/cos81e

Interpreting the order code

The order code and serial number of your product can be found in the following locations:
- On the nameplate
- In the delivery papers
- As a DMC on the Memosens plug-in head (can be read via the E+H Operations App)

Obtaining information on the product

1. Open www.endress.com.
2. Call up the site search (magnifying glass).
3. Enter a valid serial number.
4. Search.
   ↳ The product structure is displayed in a popup window.
5. Click on the product image in the popup window.
   ↳ A new window (**Device Viewer**) opens. All of the information relating to your device is displayed in this window as well as the product documentation.

4.2.2 Nameplate

The following information on the device can be found on the nameplate:
- Manufacturer identification
- Order code
- Extended order code
- Serial number

- Safety information and warnings
- Ex marking on hazardous area versions
- Certificate information

▶ Compare the information on the nameplate with the order.

4.2.3 Manufacturer address

Endress+Hauser Conducta GmbH+Co. KG
Dieselstraße 24
D-70839 Gerlingen

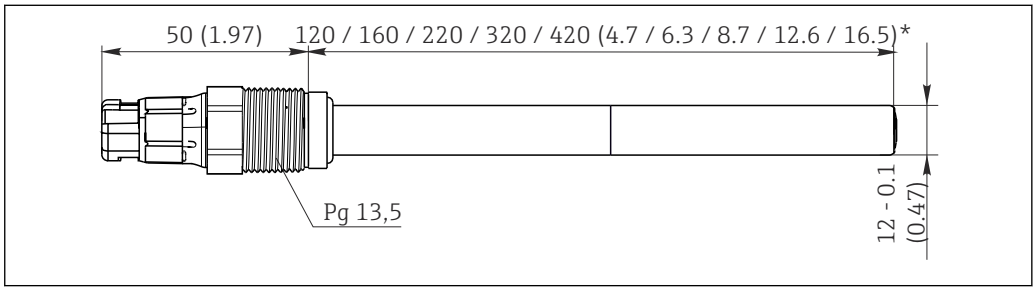
4.3 Scope of delivery

The scope of delivery comprises:
- 1 sensor, version as ordered
- 1 x Brief Operating Instructions
- Safety instructions for the hazardous area (for sensors with Ex approval)
- Supplement for optional certificates that have been ordered

5 Installation

5.1 Installation requirements

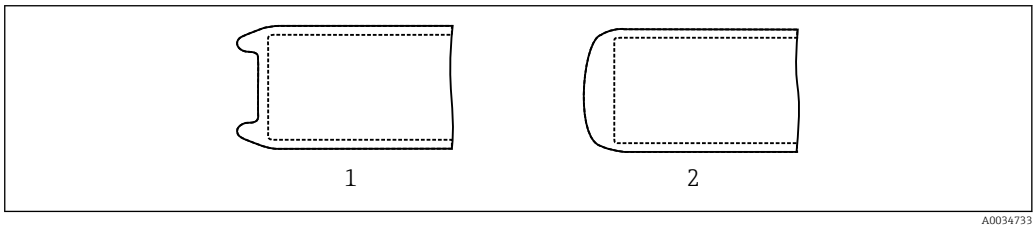
5.1.1 Dimensions



3 *Dimensions in mm (inch)*

5.1.2 Orientation

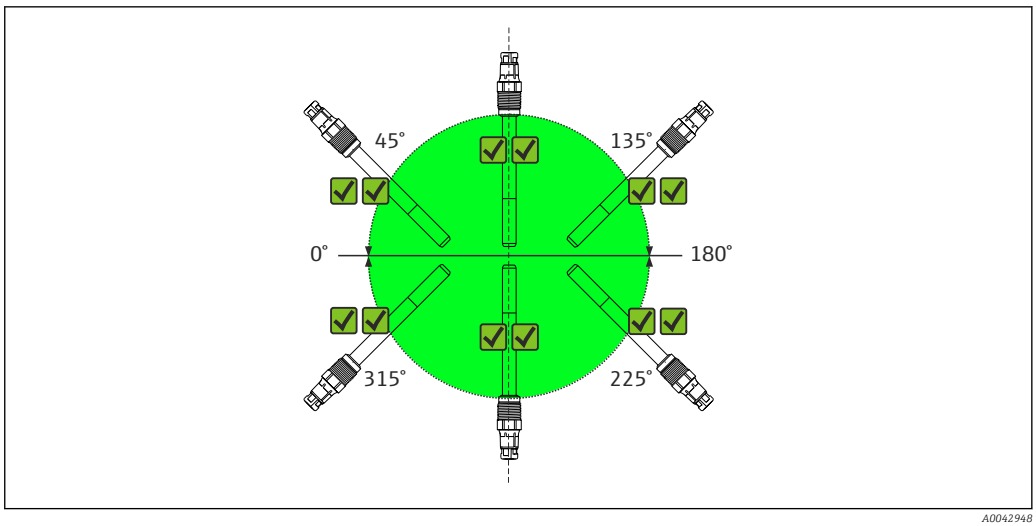
The sensor's spot cap can have either a u-shaped or c-shaped design.



4 *Design of spot cap*

1 u-shaped
2 c-shaped

COS81E-***C*** (c-shaped)**



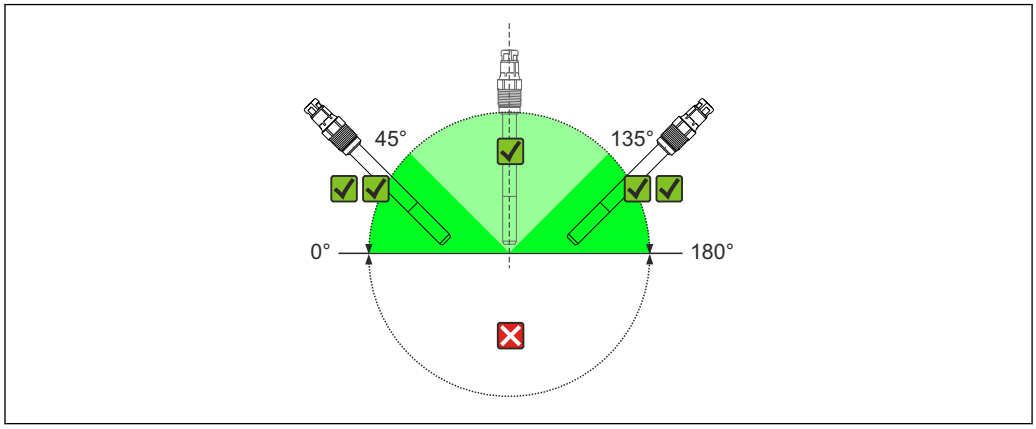
5 *Installation angle Memosens COS81E-*****C*** (c-shaped spot cap)*

The sensor can be installed at any installation angle (0 to 360 °).

✓✓ *Recommended installation angle*

The sensor with the c-shaped spot cap is self-draining in the recommended installation angles and can therefore be used for hygienic applications.

COS81E-***U*** (u-shaped)**



6 *Installation angle Memosens COS81E-*****U*** (U-shaped spot cap)*

✓✓ *Recommended installation angle*

✓ *Possible installation angle*

✗ *Inadmissible installation angle*

The sensor with the u-shaped spot cap must be installed at an angle of inclination of 0° to 180° in an assembly, holder or a corresponding process connection. Recommended angle: 0° to 45° or 135° to 180° to prevent the attachment of air bubbles. At angles of inclination of 45° to 135°, air bubbles at the oxygen-sensitive membrane may increase the measured value.

Inclination angles other than those mentioned are not permitted. In order to avoid buildup and condensation on the spot, do **not**not install the COS81E-*****U ***sensor upside down.

Follow the instructions for installing sensors in the Operating Instructions for the assembly used.

5.1.3 Installation location

1. Choose a mounting location that is easy to access.
2. Ensure that upright posts and assemblies are fully secured and vibration-free.
3. Choose a mounting location with an oxygen concentration that is typical for the application.

5.1.4 Hygienic requirements

The use of an EHEDG-certified assembly is a prerequisite for the easy-to-clean installation of a 12-mm sensor in accordance with EHEDG requirements.

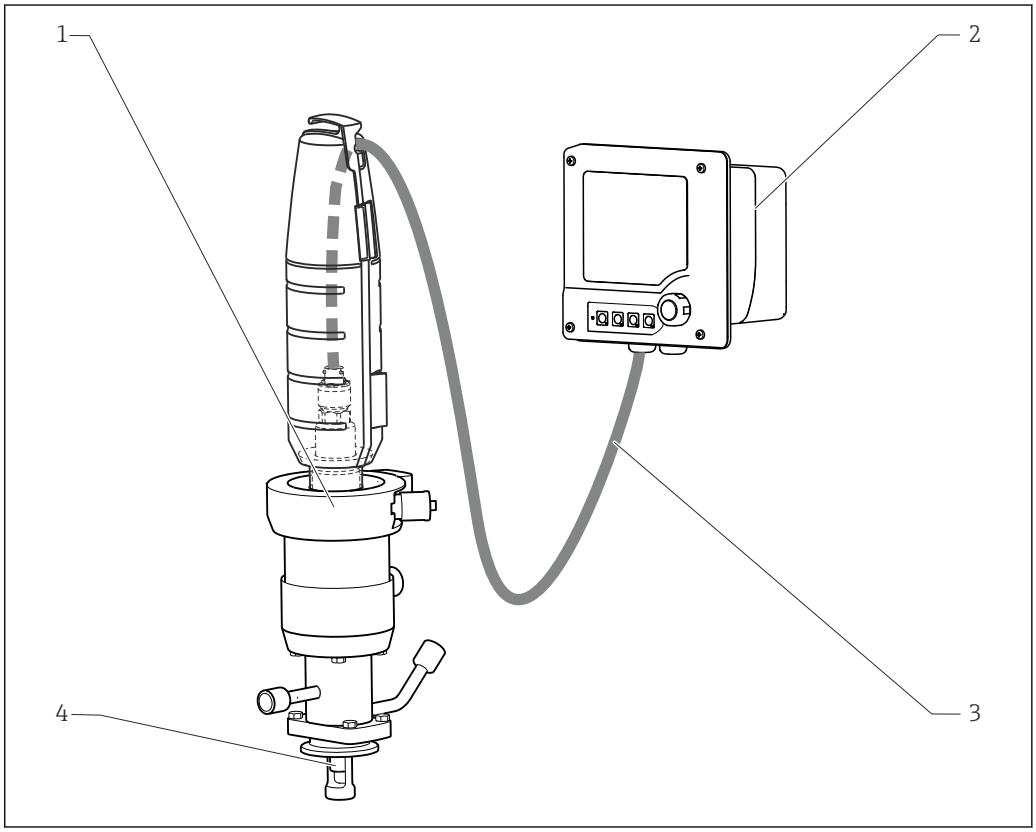
The Special Documentation for hygienic applications must be observed for hygienic operation.

Special Documentation for hygienic applications, SD02751C

5.2 Installing the sensor

5.2.1 Measuring system

A complete measuring system comprises:
- a Memosens COS81E oxygen sensor
- a measuring cable e.g. CYK10
- a transmitter, e.g. Liquiline CM42, Liquiline CM44x/R, Liquiline CM44P, Liquiline Compact CM72/82, Liquiline Mobile CML18
- Optional: an assembly, e.g. permanent installation assembly Unifit CPA842, flow assembly Flowfit CYA21 or retractable assembly Cleanfit CPA875
- Optional: connection to an analog fermenter controller via Memosens analog converter CYM17



7 *Example of a measuring system with Memosens COS81E*

1 *Retractable assembly Cleanfit CPA875*
2 *Liquiline CM42 transmitter*
3 *Measuring cable CYK10*
4 *Oxygen sensor Memosens COS81E*

5.2.2 Installing at a measuring point

Must be installed in a suitable assembly (depending on the application).

⚠ WARNING

Electrical voltage

In the event of a fault, non-grounded metallic assemblies may be live and as such are not safe to touch!

▶ When using metallic assemblies and installation equipment, national grounding provisions must be observed.

For complete installation of a measuring point , follow the steps below in the order given.

1. Install the retractable assembly or flow assembly (if used) into the process.
2. Connect the water supply to the rinse connections (if using an assembly with a cleaning function).
3. Connect the cable to the sensor and transmitter.
4. Supply power to the transmitter.
5. Install and connect the oxygen sensor in the assembly.

NOTICE

Installation errors

Cable break, loss of sensor due to cable separation, unscrewing of the spot cap!

- Do not install the sensor freely suspended from the cable!
- Hold the sensor body steady during installation or removal. **Only turn the hexagonal nut** on the high-strength cable gland. Otherwise the spot cap might be unscrewed and will then remain in the assembly or process.
- Avoid exerting excessive tensile force on the cable (e.g. through jerky pulling movements).
- Choose an installation location that is easy to access for later calibrations.
- Follow the instructions for installing sensors in the Operating Instructions for the assembly used.

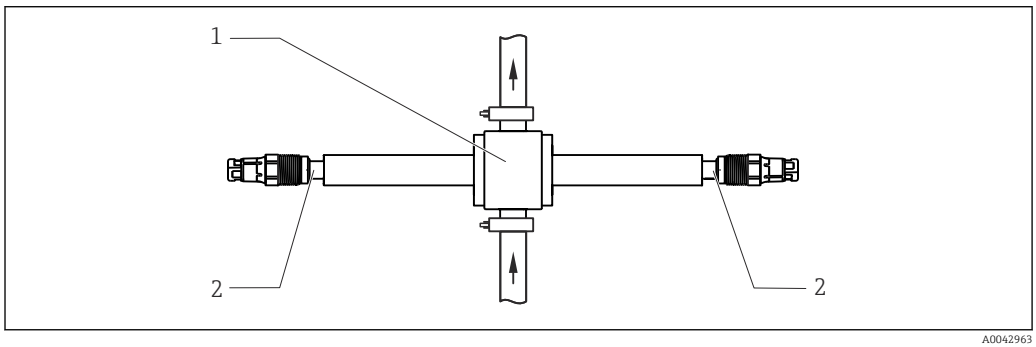
5.3 Installation examples

5.3.1 Permanent installation assembly Unifit CPA842

The permanent installation assembly CPA842 enables easy adaptation of a sensor to nearly any process connections from Ingold nozzles to Varivent or Tri-Clamp connections. This kind of installation is very well suited for tanks and larger pipes. This enables a defined immersion depth of the sensor into the medium in the simplest way.

5.3.2 Flow assembly CYA680

The flow assembly is available in various nominal diameters and materials. It can be installed both in horizontal and vertical pipes. The assembly can be operated with 1 or 2 sensors.

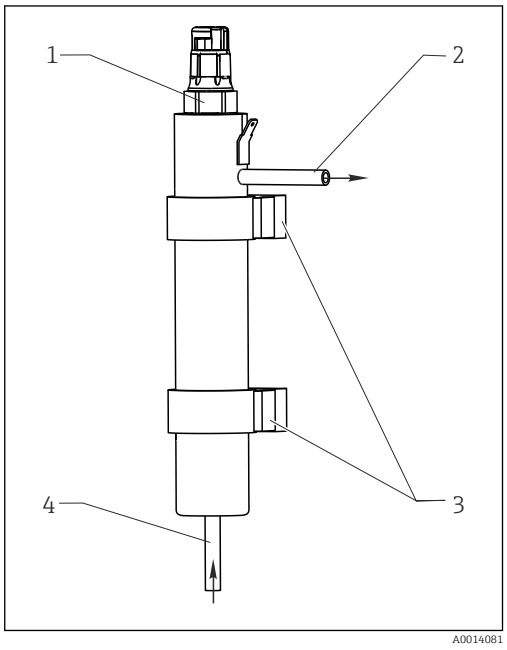


8 Flow assembly CYA680

1 Flow chamber of assembly
2 Installed sensor Memosens COS81E

5.3.3 Flow assembly Flowfit CYA21 for water treatment and processes

The compact stainless steel assembly offers space for a 12 mm sensor with a length of 120 mm . The assembly has a low sampling volume and, with the 6-mm connections, it is best suited for residual oxygen measurement in water treatments and boiler feedwater. The flow comes from below.



9 Flow assembly CYA21

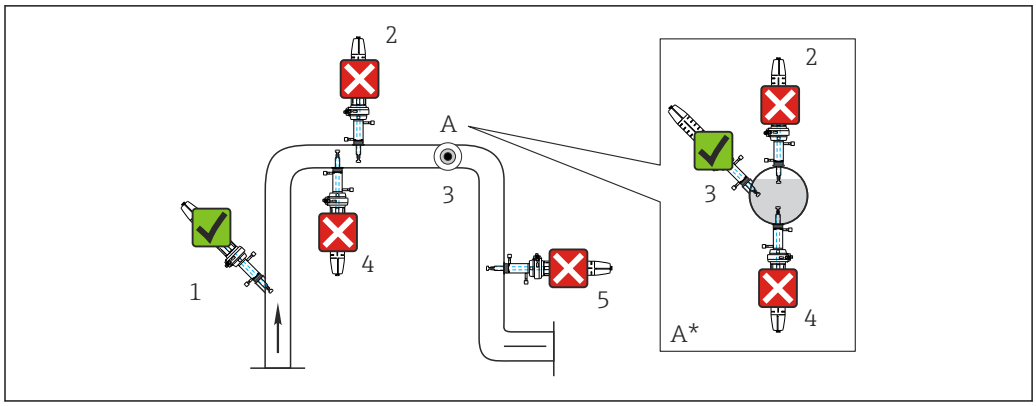
1 Installed Memosens COS81E sensor
2 Drain
3 Wall mount (clamp D29)
4 Inflow

5.3.4 Retractable assembly Cleanfit CPA875 or Cleanfit CPA450

The assembly is designed for installation on vessels and pipes. This requires the availability of suitable process connections.

Install the assembly in a place with uniform flow conditions. The pipe diameter must be at least DN 80.

Installation position for COS81E-****U*** (with u-shaped spot cap)



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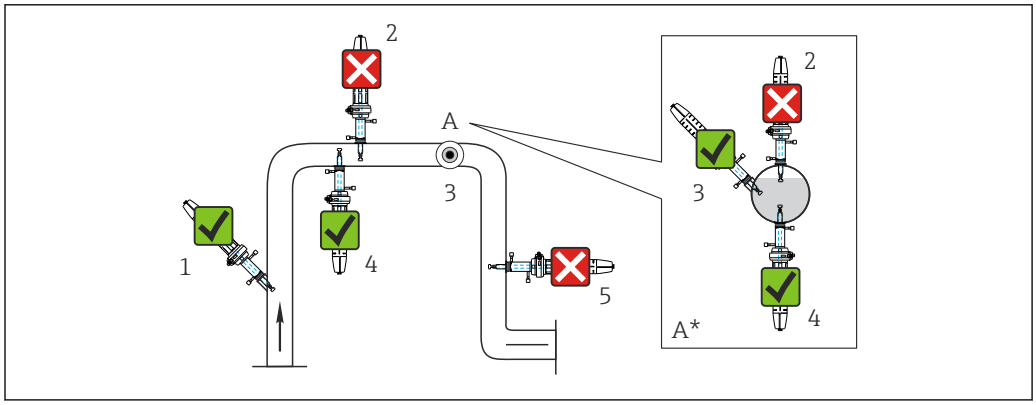
10 *Suitable and unsuitable installation positions for Memosens COS81E with u-shaped spot cap and retractable assembly*

1 Ascending pipe, best position
2 Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming
3 Horizontal pipe, lateral installation, with suitable installation angle
4 Upside-down installation, unsuitable
5 Down pipe, impermissible
A Detail A (top view)
A Detail A, turned by 90° (side view)*

✓ *Possible installation angle*

✗ *Inadmissible installation angle*

Installation position for COS81E-****C*** (with c-shaped spot cap)



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11 *Suitable and unsuitable installation positions for Memosens COS81E with c-shaped spot cap and retractable assembly*

1 Ascending pipe, best position
2 Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming
3 Horizontal pipe, lateral installation with permissible installation angle (acc. to sensor version)
4 Upside-down installation, only in conjunction with c-shaped spot cap
5 Down pipe, impermissible

✓ *Possible installation angle*

✗ *Inadmissible installation angle*

NOTICE

Sensor not fully immersed in the medium, buildup, upside-down installation

These can all cause incorrect measurements!

- ▶ Do not install assembly at points where air pockets or bubbles may form.
- ▶ Avoid buildup on the spot cap or remove it at regular intervals.
- ▶ Do not install sensor COS81E-****U (u-shaped) upside down.

5.4 Post-installation check

1. Are the sensor and cable undamaged?
2. Is the orientation correct?
3. Is the sensor installed in an assembly and is not suspended from the cable?
4. Avoid the penetration of moisture.

6 Electrical connection

⚠ WARNING

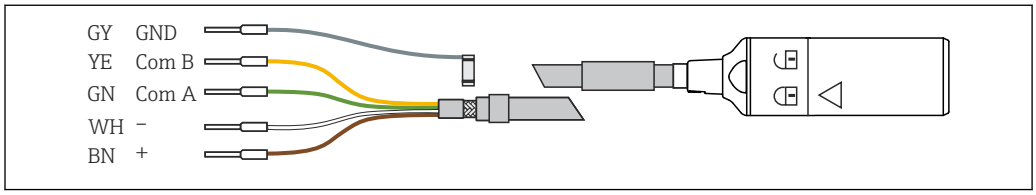
Device is live!

Incorrect connection may result in injury or death!

- The electrical connection may be performed only by an electrical technician.
- The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- **Prior** to commencing connection work, ensure that no voltage is present on any cable.

6.1 Connecting the sensor

The electrical connection of the sensor to the transmitter is established using measuring cable CYK10.



12 *Measuring cable CYK10*

6.2 Ensuring the degree of protection

Only the mechanical and electrical connections which are described in these instructions, and which are necessary for the required intended use, may be established on the device delivered.

- Exercise care when carrying out the work.

Otherwise, the individual types of protection (Ingress Protection (IP), electrical safety, EMC interference immunity) agreed for this product can no longer be guaranteed due, for example, to covers being left off or cable (ends) that are loose or insufficiently secured.

6.3 Post-connection check

Device health and specifications	**Action**
Is the outside of the sensor, assembly or cable free from damage?	▸ Perform a visual inspection.
Electrical connection	**Action**
Are the mounted cables strain-relieved and not twisted?	▸ Perform a visual inspection. ▸ Untwist the cables.
Is a sufficient length of the cable cores stripped, and are the cores positioned in the terminal correctly?	▸ Perform a visual inspection. ▸ Pull gently to check they are seated correctly.
Are all screw terminals tightened?	▸ Tighten the screw terminals.
Are all cable entries mounted, firmly tightened and leak-tight?	▸ Perform a visual inspection. In the case of lateral cable entries:
Are all cable entries mounted on the side or pointing downwards?	▸ Point cable loops downward so that water can drip off.

7 Commissioning

7.1 Installation and function check

Prior to initial commissioning, ensure that:
- Is the sensor correctly installed?
- Is the electrical connection correct?

If using an assembly with automatic cleaning function:

▶ Check that the cleaning medium (water or air, for example) is connected correctly.

⚠ WARNING

Escaping process medium

Risk of injury from high pressure, high temperatures or chemical hazards!

▶ Before applying pressure to an assembly with cleaning system, ensure that the system has been connected correctly.

▶ If you cannot reliably establish the correct connection, do not install the assembly in the process.

1. At the transmitter, enter all the settings specific to the parameters and measuring point. These include the air pressure during calibration and measurement or the salinity, for instance.
2. Check whether a calibration/adjustment is necessary.

The oxygen measuring point is then ready to measure.

After commissioning, maintain the sensor at regular intervals to ensure reliable measurement.

Operating Instructions for the transmitter used, such as BA01245C if using the Liquiline CM44x or Liquiline CM44xR.

7.2 Calibration and adjustment

The sensor is calibrated and adjusted in the factory prior to delivery and is therefore ready for immediate use.

A recalibration or readjustment is required in the following situations:
- Changes due to process conditions, e.g. for Cleaning in Place (CIP), Sterilization in Place (SIP) and autoclaving
- Changes due to stress: temperature and/or chemicals (cleaning)
- Following a spot cap replacement

Recommended procedure after replacing a spot cap

First calibrate and adjust the sensor at the zero point and then in the presence of oxygen.

Calibration and adjustment can also be monitored or renewed cyclically (at typical time intervals, depending on operating experience), e.g. within the context of system monitoring.

7.2.1 Types of calibration

The following types of calibration are possible:
- Zero point
  - Single-point calibration in nitrogen or COY8 zero-point gel
  - Data entry
- Point at oxygen
  - Air, water vapor-saturated (recommended)
  - Air-saturated water
  - Air, variable
  - Test gas calibration
  - Data entry
  - Sample calibration
- Fermenter scaling
- Temperature adjustment

7.2.2 Zero adjustment

The zero point is not so important when working with relatively high concentrations of oxygen. In these types of application, a zero point calibration is required only after the spot cap has been replaced.

However, once oxygen sensors are used at low concentrations and in the trace range, they must also be calibrated at the zero point.

Zero point calibrations are demanding as the ambient medium - usually air - already has a high oxygen content. This oxygen must be excluded for zero point calibration of the sensor.

A calibration with the COY8 zero-point gel can be used for this purpose:
The COY8 oxygen-depleting gel creates an oxygen-free medium for zero point calibration.

Prior to sensor zero point calibration, check the following:
- Is the sensor signal stable?
- Has the adjustment time of 30 min - 40 min for the COY8 zero-point gel elapsed?
- Is the value displayed plausible?

1. If the sensor signal is stable:
   Calibrate the zero point.
2. If necessary:
   Adjust the sensor by accepting the calibration data.

If the oxygen sensor is calibrated too early, this can result in an incorrect zero point.

Rule of thumb: operate the sensor for at least 30 min in the COY8 zero-point gel.

Follow the instructions in the kit documentation enclosed with the COY8 zero-point gel.

7.2.3 Calibration in air with 100% rH

1. Remove the sensor from the medium.
2. Clean the outside of the sensor carefully with a damp cloth.
3. Suspend the sensor just above the surface of the water.
   Do not immerse the sensor.
4. Allow a temperature compensation time of approx. 20 minutes for the sensor in the ambient air. Make sure that the sensor is not exposed to any direct ambient effects (direct sunlight, drafts) during this time.

5. Is the measured value display on the transmitter stable:
   Perform the calibration in accordance with the Operating Instructions for the transmitter. Pay particular attention to the software settings for the stability criteria for calibration and for the ambient pressure.
6. Where necessary:
   Adjust the sensor by accepting the calibration data.
7. Then place the sensor back into the medium.
8. Deactivate the hold status at the transmitter.

▶ Follow the calibration instructions in the Operating Instructions for the transmitter used.

The constants K_{sv} and Tau0 of the Stern-Volmer equation are determined at both calibration points (point in oxygen and zero point). The calibration quality index provides an indication of the quality of the calibration in relation to the first reference calibration of the spot cap. Therefore it is important to run the **Change sensor cap** command in the calibration menu of the transmitter before every initial calibration of a spot cap.

7.2.4 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 following:

- Ambient temperature for the sensor (air temperature for **Air 100% rh** or **Air variable** calibration types, water temperature for **H2O air-saturated** calibration type)
- The altitude above sea level
- The current air pressure (= relative air pressure based on sea level) at the time of calibration. (If indeterminable, use 1013 hPa.)

2. Determine the following:

- The saturation value S acc. to Table 1
- The altitude factor K acc. to Table 2

Table 1

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						

Table 2

Height [m (ft)]	K	Height [m (ft)]	K	Height [m (ft)]	K	Height [m (ft)]	K
0 (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 factor **L**:

$$L = \frac{\text{Relative air pressure at calibration}}{\text{1013 hPa}}$$

4. Determine the **M** factor:

- **M** = 1.02 (for **Air 100% rh** calibration type)
- **M** = 1.00 (for **H2O air-saturated** calibration type)

5. Calculate calibration value **C**:

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

Example
- Air calibration at 18 °C (64 °F), altitude 500 m (1650 ft) above sea level, current air pressure 1009 hPa
- S = 9.45 mg/l, K = 0.943, L = 0.996, M=1.02
- Calibration value C = 9.05 mg/l.

Factor K in the table is not required if the measuring device returns the absolute air pressure L_{abs} (air pressure depending on altitude) as the measured value. The formula for calculation is then: $C = S \cdot L_{abs}$.

7.2.5 Measured value filter

In the sensor setup of the transmitter (e.g. from CM44x Release 1.09.00), various measured value filters can be configured for COS81E and saved in the sensor.

The following measured value filters are available:
- Standard
  Responsive filter that quickly captures all changes in the oxygen content (default)
- Extended - weak
  Optimized filter for use of the sensor in fermenter applications
- Extended - strong
  Strong filter for use of the sensor in fermenter applications in which oxygen regulation is complicated by small accumulations of air bubbles on the sensor due to the consistency of the medium

8 Diagnostics and troubleshooting

8.1 General troubleshooting

▶ If one of the following problems is present:
Check the measuring system in the order shown.

Problem	Test	Remedy
Blank display, no sensor reaction	Power supplied to the transmitter?	▶ Establish the power supply. ▶ Switch on channel on transmitter.
	Sensor cable connected correctly?	▶ Establish correct connection.
	Buildup on the spot cap?	▶ Clean the spot cap or luminescence layer carefully with a soft cloth.
Displayed value too high	Is sensor calibrated/adjusted? Measured value in air not 100 ± 2 %SAT?	▶ Recalibrate/readjust. ↳ When calibrating, enter the current air pressure at the transmitter.
	Displayed temperature clearly too low?	▶ Check sensor; contact the Endress+Hauser Sales Center if necessary.
Displayed value too low	Is sensor calibrated/adjusted? Measured value in air not 100 ± 2 %SAT?	▶ Recalibrate/readjust. ↳ When calibrating, enter the current air pressure at the transmitter.
	Displayed temperature clearly too high?	▶ Check sensor; contact the Endress+Hauser Sales Center if necessary.
Display value fluctuating	Are there air bubbles on the spot cap?	1. Change the installation angle. 2. If necessary, change the cap type from a u-shaped to a c-shaped cap.
Display in Vol% or %SAT not plausible	Medium pressure not taken into account	▶ Enter medium pressure on transmitter.
F005 after transmitter replacement	Measured value filter setting changed?	Update the transmitter to the most recent software version or, on the transmitter with the latest software version, adjust the filter setting to the medium again and continue using the older transmitter software.

Pay attention to the troubleshooting information in the Operating Instructions for the transmitter. Check the transmitter if necessary.

9 Maintenance

Take all the necessary precautions in time to ensure the operational safety and reliability of the entire measuring system.

NOTICE

Effects on process and process control!

- When carrying out any work on the system, bear in mind any potential impact this could have on the process control system and the process itself.
- For your own safety, only use genuine accessories. With genuine parts, the function, accuracy and reliability are also ensured after maintenance work.

9.1 Maintenance schedule

Maintenance cycles depend to a great extent on the operating conditions.

The following rule of thumb applies:

- Constant conditions, e.g. power plant = long cycles (6 months)
- Widely varying conditions, e.g. daily CIP or SIP cleaning, fluctuating process pressure = short cycles (1 month or less)

The following method helps you determine the necessary intervals:

1. Inspect the sensor one month after commissioning. To do so, remove the sensor from the medium and dry it carefully.
2. Visually check the spot cap.
   ↳ There should be no green coloration or air bubbles visible on the exterior. Otherwise, replace the spot cap.
3. After 10 minutes, measure the oxygen saturation index in air.
   ↳ Decide using the results:
   a) Measured value is not 100 ± 2 % SAT? → Service the sensor.
   b) Measured value = 100 ± 2 % SAT? → Double the length of time to the next inspection.
4. Proceed as indicated in Step 1 after two, four and eight months.
   ↳ This allows you to determine the optimum maintenance interval for your sensor.

Especially in the case of widely fluctuating process conditions, damage to the luminescence layer may also occur within a maintenance cycle. This is indicated by implausible sensor behavior.

9.2 Maintenance tasks

The following tasks must be performed:

1. Clean the sensor and spot cap.
2. Replace wear parts or consumables.
3. Check measurement function.
4. Recalibrate (if desired or necessary).
   ↳ Follow the Operating Instructions for the transmitter.

9.2.1 Cleaning the exterior of the sensor

Dirt on the sensor can impact the measurement and even cause a malfunction. Examples include buildup on the spot cap, which can cause a longer response time.

The sensor must be cleaned at regular intervals for reliable measurement results. The frequency and intensity of the cleaning process depend on the medium.

Clean the sensor:
- Before every calibration
- At regular intervals during operation as necessary
- Before returning it for repair

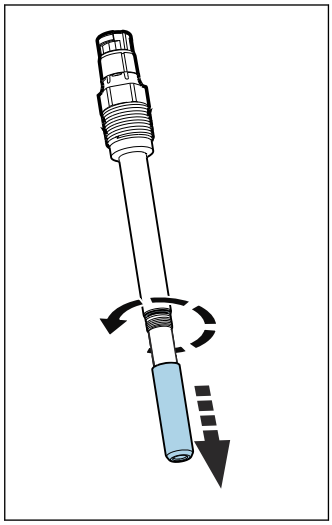
Type of contamination	Cleaning
Salt deposits	1. Immerse the sensor in drinking water. 2. Then rinse it with copious amounts of water.
Dirt particles on the sensor shaft and shaft sleeve (**not spot cap!**)	▶ Clean sensor shaft and sleeve with water and a suitable sponge.
Dirt particles on the spot cap	▶ Clean the spot cap with water. No mechanical cleaning.

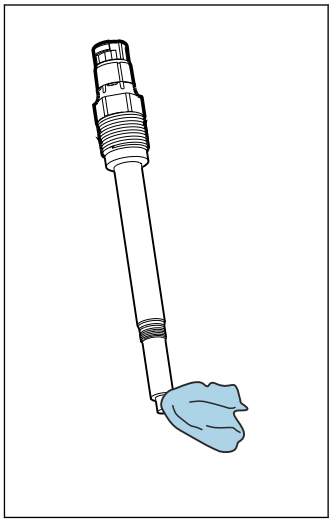
▶ After cleaning:
Rinse with copious amounts of clean water.

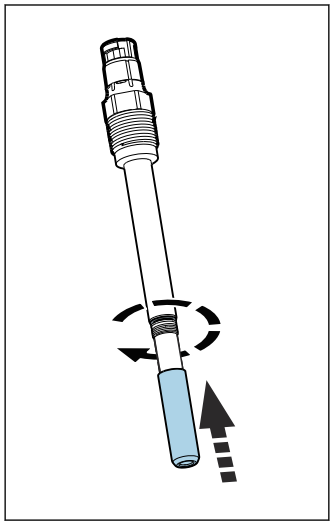
Use a fully automated cleaning system for regular automated cleaning.

9.2.2 Cleaning the sensor optics

The optics need to be cleaned only if there is visible buildup on the optical waveguide or boundary area.


A0043084


A0043085


A0043086

1. Unscrew the spot cap from the sensor head.
2. Carefully clean the optical surface with a soft cloth until the buildup is fully removed. If necessary wet the cloth with drinking water or distilled water (preferably use the cleaning cloth supplied with the COV81 maintenance kit) .
3. Dry the optical surface and screw on a functioning spot cap.
4. At the transmitter, execute the **Sensor cap change** command and then perform the necessary calibrations.

NOTICE

Damage, scratches on optical surface
Distorted measured values
▶ Make sure that the optical surface is not scratched or damaged in any other way.

10 Repair

10.1 General information

- Only use spare parts from Endress+Hauser to guarantee the safe and stable functioning of the device.

Detailed information on the spare parts is available at:
www.endress.com/device-viewer

10.2 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product was ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

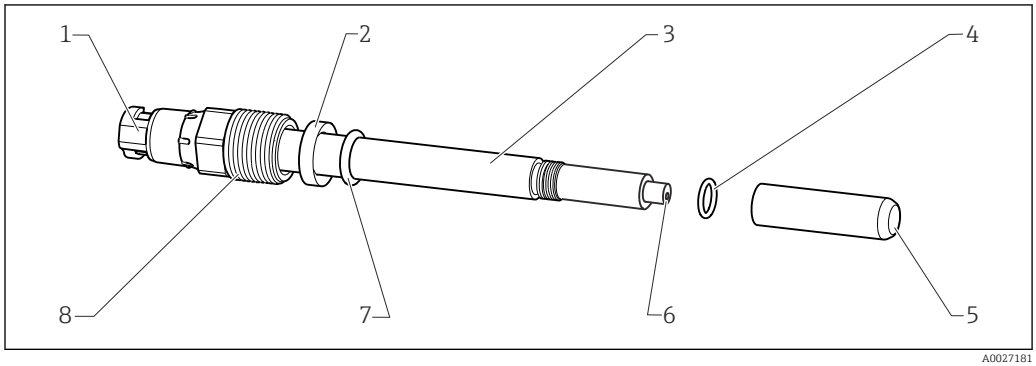
To ensure the swift, safe and professional return of the device:

- Check the website www.endress.com/support/return-material for information on the procedure and general conditions.

10.3 Spare parts and consumables

Parts of the sensor are subject to wear during operation. By taking suitable measures, you can restore the normal operating function.

Action required	Reason
Replace process seals	Visible damage to a process seal
Replace spot cap	▪ Luminescence layer ▪ Visible damage to the O-ring



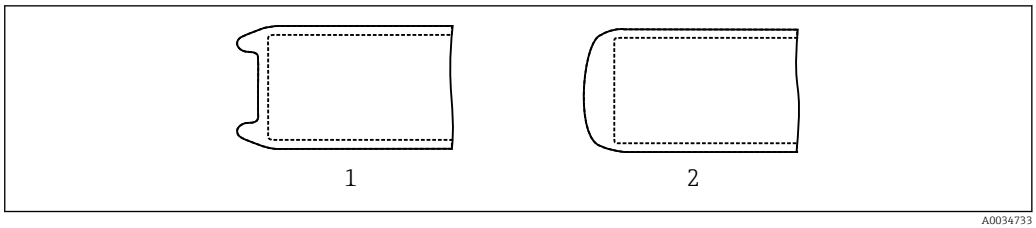
13 Memosens COS81E

1	*Memosens plug-in head with optics assembly*	*5*	*Spot cap*
2	*Thrust collar*	*6*	*Optical waveguide with temperature sensor*
3	*Sensor shaft*	*7*	*Process seal 10.77 x 2.62 mm*
4	*O-ring sensor shaft*	*8*	*Process connection Pg 13.5*

The suitability of the selected materials for use in the process must be assessed during the product configuration.

Process conditions that go beyond the resistance range of the materials may shorten the operating life of the materials and make maintenance necessary.

The sensor's spot cap can have either a u-shaped or c-shaped design.



14 *Design of spot cap*

1 u-shaped
2 c-shaped

Memosens COV81 maintenance kits

- Maintenance kit for COS81E
- Scope of delivery of the Memosens COV81 maintenance kit is based on the configuration:
  - Spot cap
  - O-ring mounting tool
  - Cleaning cloth for optics
  - O-rings
  - Certificates, test certificates or manufacturer declarations
- Ordering information: www.endress.com/cos81e under "Accessories/spare parts"

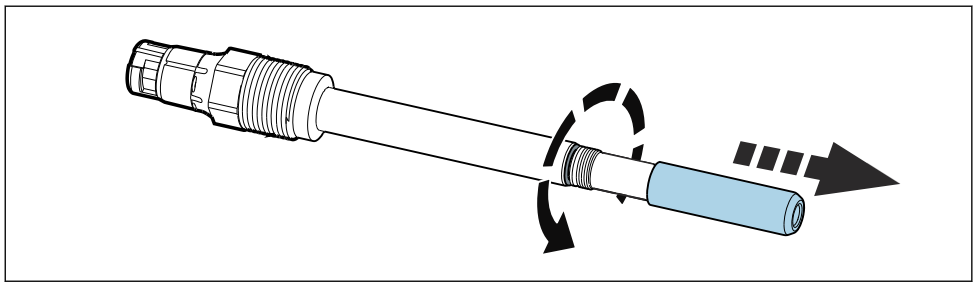
10.3.1 Replacing sealing rings

It is compulsory to replace the sealing ring if it is visibly damaged. Only use original sealing rings.

The following O-rings can be replaced:
- Sealing ring for shaft sleeve: Item 4
- Sealing ring for process (conductive for Ex): Item 8

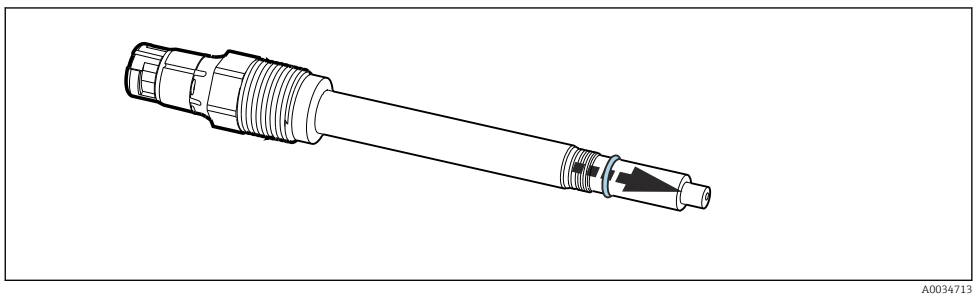
Replacing the sealing ring for the shaft sleeve

1.



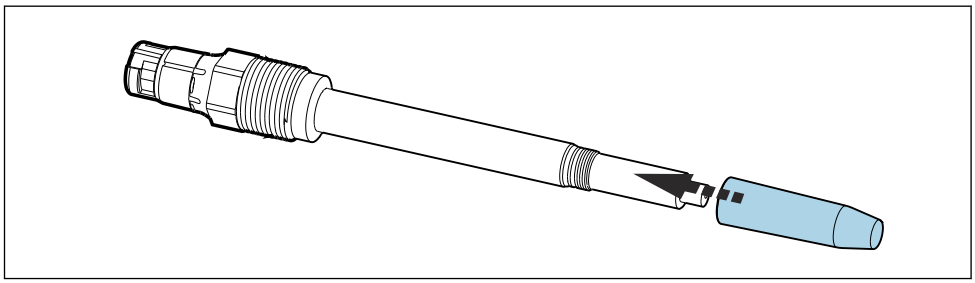
Unscrew the membrane cap.

2.



Remove the old O-ring above the thread on the shaft.

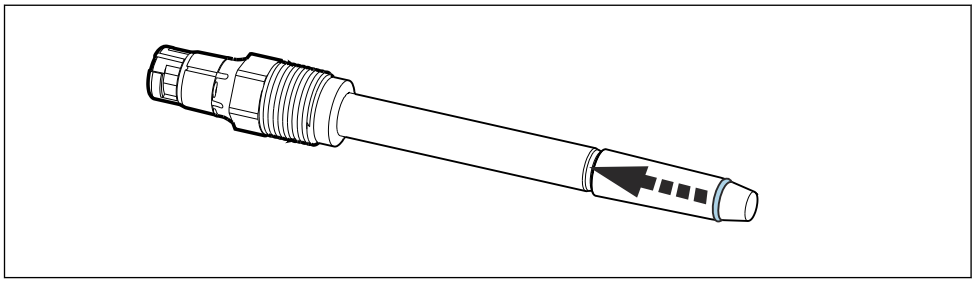
3.



A0034715

Push the mounting tool from below onto the shaft until it sits over the thread.

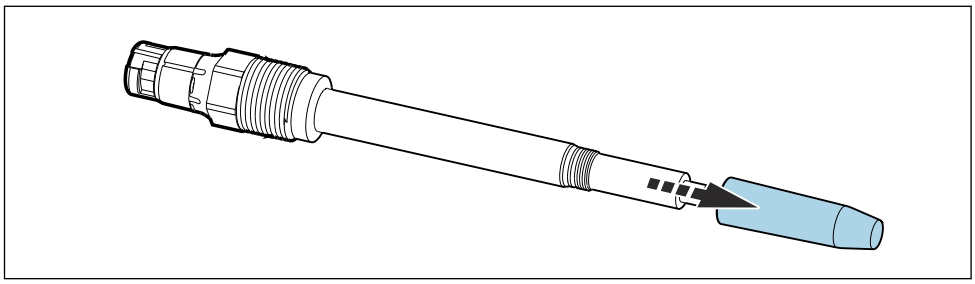
4.



A0034717

Slide the new O-ring over the mounting tool into the position above the thread.

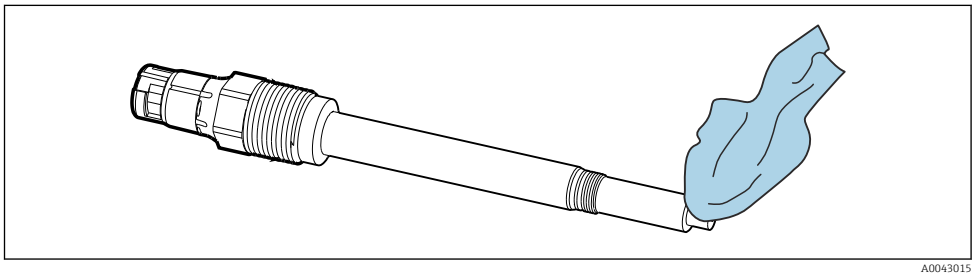
5.



A0043012

Remove the mounting tool.

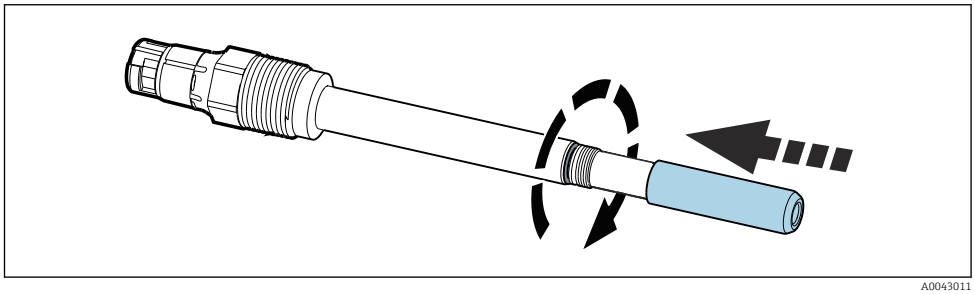
6.



A0043015

Clean the sensor optics carefully using the cloth provided.

7.

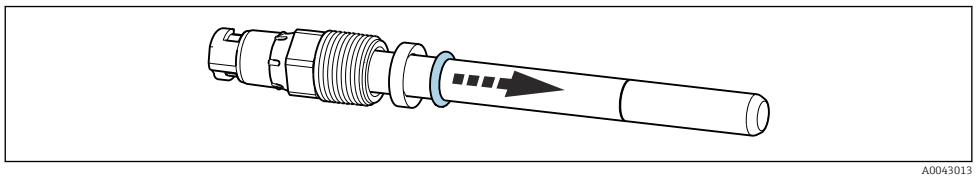


A0043011

Screw on the membrane cap.

Replacing the sealing ring for the process

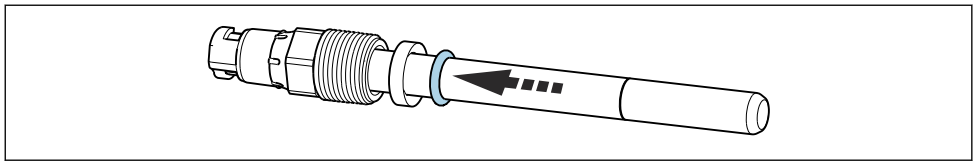
8.



A0043013

Remove the old O-ring on the process connection in the direction of the membrane cap.

9.



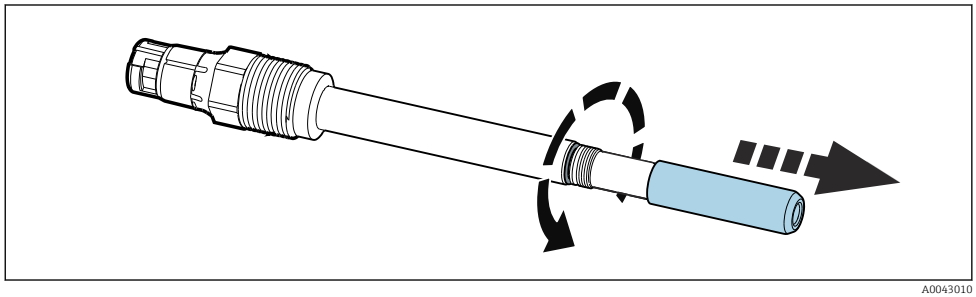
A0043014

Fit the new O-ring over the membrane cap and push it as far as the process connection.

10.3.2 Replacing the spot cap

The spot cap must be replaced if it is visibly damaged or the sensor measurement quality is not sufficient. Only use original spot caps.

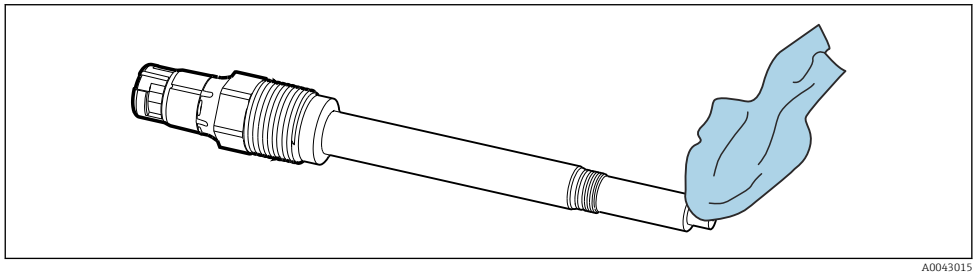
1.



A0043010

Unscrew the old spot cap and remove.

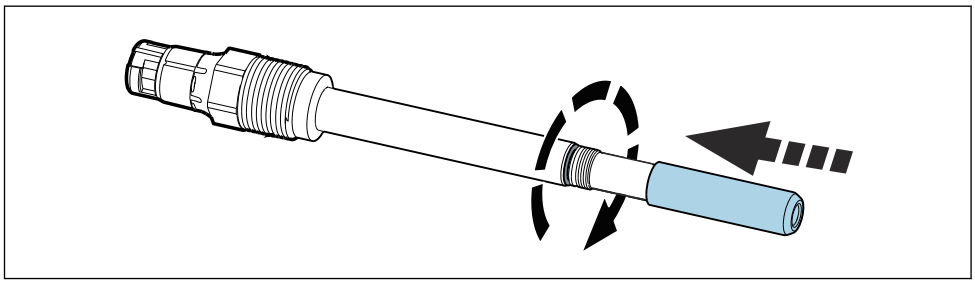
2.



A0043015

Clean the sensor optics carefully using the cloth provided.

3. Reset the cap counters.
   ↳ Warnings can be configured for the spot cap counters to assist with sensor maintenance.

4. 

   Screw on the new spot cap.

5. Calibrate the sensor and check the measurement function.→ 21

10.4 Checking the measurement function

1. Remove the sensor from the medium.
2. Clean and dry the spot cap.
3. Adjust the process pressure on the transmitter if it differs from the atmospheric pressure, as otherwise no comparison is possible.
4. After about 10 minutes, measure the oxygen saturation index in air (without recalibration).
   ↳ The measured value should be at 100 ± 2 %SAT.

10.5 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to Endress+Hauser for disposal under the applicable conditions.

11 Accessories

The following are the most important accessories available at the time this documentation was issued.

▶ For accessories not listed here, please contact your Service or Sales Center.

11.1 Device-specific accessories

11.1.1 Assemblies (selection)

COS81E with 220 mm length is suitable for all assemblies requiring an installation length of 225 mm.

Cleanfit CPA875
- Retractable process assembly for sterile and hygienic applications
- For in-line measurement with standard sensors with 12 mm diameter, e.g. for pH, ORP, oxygen
- Product Configurator on the product page: www.endress.com/cpa875

Technical Information TI01168C

Cleanfit CPA450
- Manual retractable assembly for installing sensors with a diameter of 12 mm and a length of 120 mm in tanks and pipes
- Product Configurator on the product page: www.endress.com/cpa450

Technical Information TI00183C

Unifit CPA842
- Hygienic installation assembly for food, biotechnology and pharmaceuticals
- For in-line measurement with standard sensors with 12 mm diameter, e.g. for pH, ORP, oxygen
- Product Configurator on the product page: www.endress.com/cpa842

Technical Information TI00306C

Flowfit CPA240
- pH/redox flow assembly for processes with stringent requirements
- Product Configurator on the product page: www.endress.com/cpa240

Technical Information TI00179C

Flowfit CYA21
- Universal assembly for analysis systems in industrial utilities
- Product Configurator on the product page: www.endress.com/CYA21

Technical Information TI01441C

CYA680
- Flow assembly for hygienic sensors
- For sensor installation in pipes
- Suitable for cleaning in place (CIP) and sterilization in place (SIP)
- Product Configurator on the product page: www.endress.com/cya680

Technical Information TI01295C

11.1.2 Measuring cable

Memosens data cable CYK10
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10

Technical Information TI00118C

Memosens data cable CYK11
- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: www.endress.com/cyk11

Technical Information TI00118C

Memosens laboratory cable CYK20
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk20

11.1.3 Zero-point gel

COY8

Zero-point gel for oxygen and disinfection sensors
- Oxygen-free and chlorine-free gel for the verification, zero point calibration and adjustment of oxygen and disinfection measuring points
- Product Configurator on the product page: www.endress.com/coy8

Technical Information TI01244C

11.1.4 Transmitter

Liquiline CM44
- Modular multi-channel transmitter for hazardous and non-hazardous areas
- HART®, PROFIBUS, Modbus or EtherNet/IP is possible
- Order according to product structure

Technical Information TI00444C

Liquiline CM42
- Modular two-wire transmitter for hazardous and non-hazardous areas
- HART®, PROFIBUS or FOUNDATION Fieldbus is possible
- Order according to product structure

Technical Information TI00381C

Liquiline Mobile CML18
- Multiparameter mobile device for laboratory and field
- Reliable transmitter with display and app connection
- Product Configurator on the product page: www.endress.com/CML18

Operating Instructions BA02002C

Liquiline Compact CM82
- Configurable 1-channel multiparameter transmitter for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM82

Technical Information TI01397C

Liquiline Compact CM72
- 1-channel single parameter field device for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM72

Technical Information TI01409C

Memosens analog converter CYM17
- Converter for Memosens sensors
- Enables the simple use of digital Memosens sensors in fermentation applications in the laboratory
- Product Configurator on the product page: www.endress.com/cym17

Operating Instructions BA01833C

Memobase Plus CYZ71D
- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d

Technical Information TI00502C

11.1.5 Maintenance kit

Memosens COV81 maintenance kits

- Maintenance kit for COS81E
- Scope of delivery of the Memosens COV81 maintenance kit is based on the configuration:
  - Spot cap
  - O-ring mounting tool
  - Cleaning cloth for optics
  - O-rings
  - Certificates, test certificates or manufacturer declarations
- Ordering information: www.endress.com/cos81e under "Accessories/spare parts"

12 Technical data

12.1 Input

Measured variables

Dissolved oxygen [mg/l, µg/l, ppm, ppb, %SAT or hPa]

Oxygen (gaseous) [hPa or %Vol]

Temperature [°C, °F]

Maximum measuring range

Measuring ranges apply for 25 °C (77 °F) and 1013 hPa (15 psi)

c-shaped	u-shaped
0.004 to 26 mg/l 0.05 to 285 % SAT 0.1 to 600 hPa	0.004 to 30 mg/l 0.05 to 330 % SAT 0.1 to 700 hPa

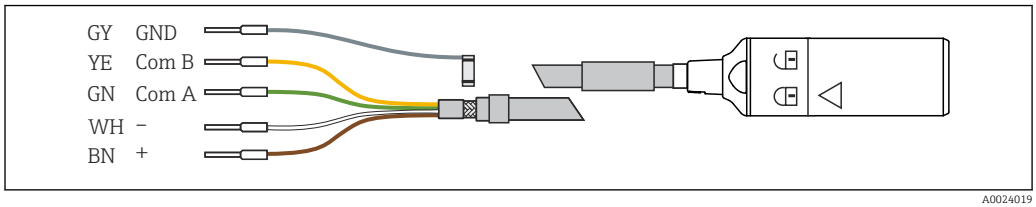
The sensor has a measuring range of up to max. 1000 hPa.

The measured errors indicated are reached in the optimum measuring range, but not over the entire measuring range.

12.2 Power supply

Electrical connection

The electrical connection of the sensor to the transmitter is established using measuring cable CYK10.



15 Measuring cable CYK10

12.3 Performance characteristics

Response time [1]

From air to nitrogen at reference operating conditions:
- t_{90} : < 10 s
- t_{98} : < 20 s

Reference operating conditions

Reference temperature:	25 °C (77 °F)
Reference pressure:	1013 hPa (15 psi)

Measurement error [2]

±1 % or ±8 µg/l (ppb)of the measured value (the higher value is relevant in each case) [3]

1) Average of all sensors that have undergone a final inspection
2) In accordance with IEC 60746-1 under rated operating conditions
3) In accordance with IEC 60746-1 at rated operating conditions

Limit of detection (LOD) [4]	COS81E	4 ppb
Limit of quantification (LOQ) [4]	COS81E	10ppb
Repeatability	2ppb	

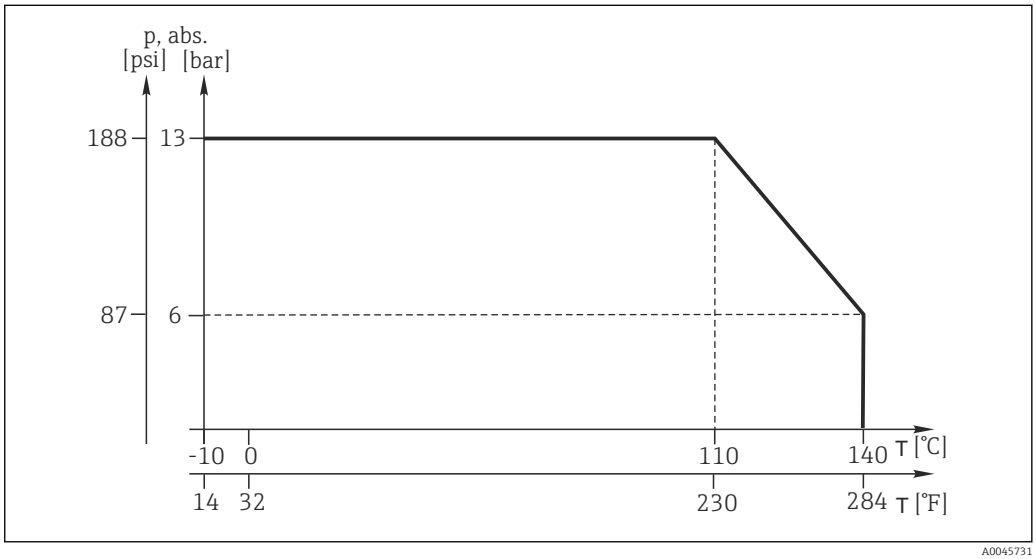
12.4 Environment

Ambient temperature range	−5 to +100 °C (23 to 212 °F)
Storage temperature range	-25 to 50 °C (-13 to 122 °F) at 95% relative humidity, non-condensing
Degree of protection	IP68 (2 m (6.5 ft) water column, 21 °C (70 °F), 24 hours) IP69

12.5 Process

Process temperature range	Normal operation c-shaped:	0 to 60 °C (32 to 140 °F)
	Normal operation u-shaped:	0 to 80 °C (32 to 175 °F)
	Sterilization (max. 45 min.):	Max. 140 °C (284 °F) at 6 bar (87 psi)
Process pressure range	0.02 to 13 bar (0 to 190 psi) abs.	

Temperature/pressure diagram



4) According to DIN EN ISO 15839. The measurement error contains all the uncertainties of the sensor and transmitter (measuring chain). It does not contain all the uncertainties caused by the reference material and adjustments that may have been performed.

Chemical resistance

NOTICE

Halogen-containing solvents, ketones and toluene

Halogen-containing solvents (dichloromethane, chloroform), ketones (e.g. acetone, pentanone) and toluene have a cross-sensitive effect and result in decreased measured values or, at worst, in the complete failure of the sensor!

► Use the sensor only in media that are free from halogens, ketones and toluene.

CIP compatibility

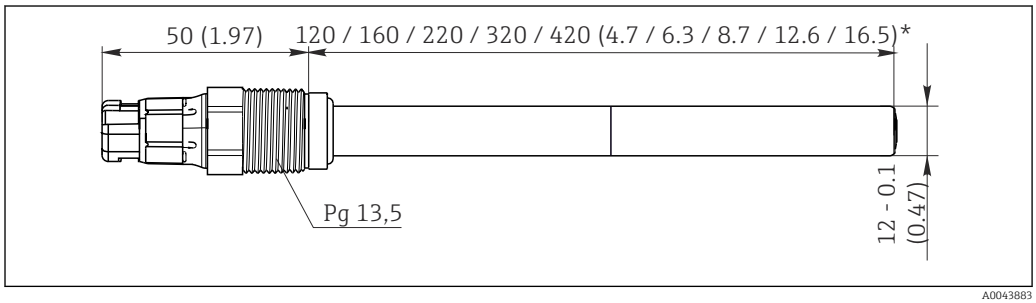
Yes

Autoclavability

Yes, max. 140 °C (284 °F)

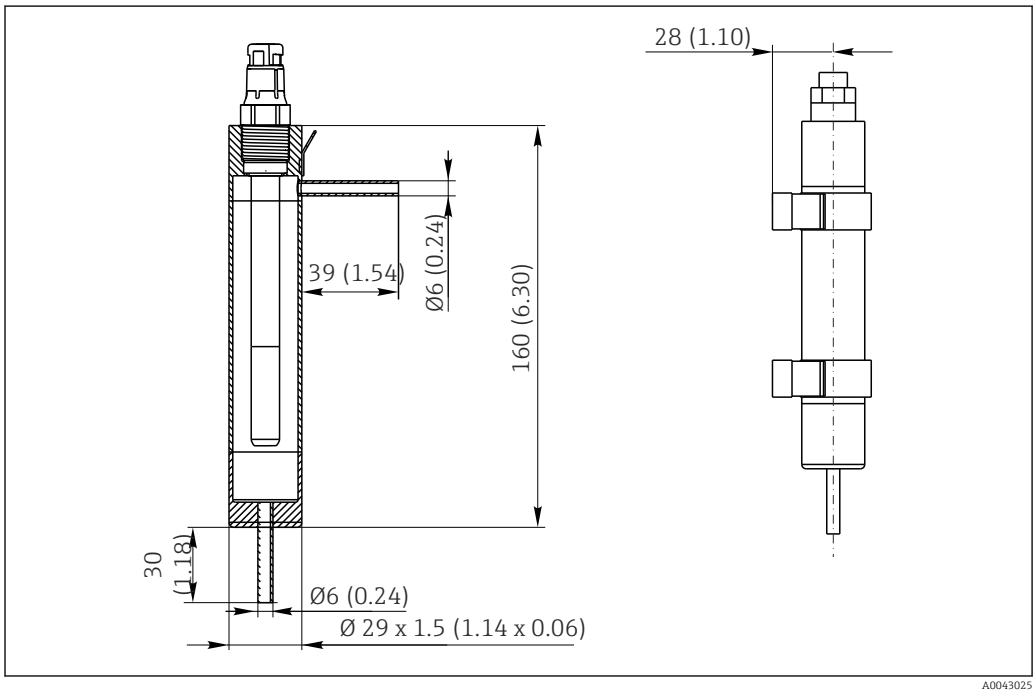
12.6 Mechanical construction

Dimensions



16 *Dimensions in mm (inch)*

Optional flow assembly CYA21 for sensors with Ø 12 mm (accessories)



17 *Dimensions in mm (inch)*

Weight

Depending on the design (length)
Example: 0.1 kg (0.20 lbs) for version with 120 mm length

Materials	**Parts in contact with medium**	
	Sensor shaft	Stainless steel 1.4435 (AISI 316L)
	Process seal	FKM
	Process seal for Ex versions	FKM
	Seals/O-rings	EPDM FFKM
	Spot cap	Stainless steel 1.4435 (AISI 316L) or titanium or Hastelloy
	Spot layer	Silicone
Process connection	Pg 13.5 Torque max. 3 Nm	
Surface roughness	R_a < 0.38 µm	
Temperature sensor	Pt1000 (Class A according to DIN IEC 60751)	

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