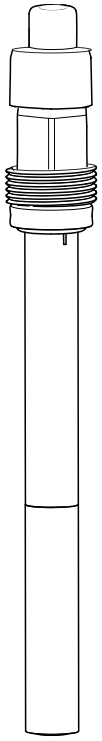
Operating Instructions
Oxymax COS22

Analog sensor for the measurement of dissolved oxygen



Endress+Hauser
People for Process Automation

Table of contents

1 Document information

1.1 Warnings

Structure of information	Meaning
DANGER **Causes (/consequences)** 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)** 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)** 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** Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols

Symbol	Meaning
	Additional information, tips
	Permitted or recommended
	Not permitted or not recommended
	Reference to device documentation
	Reference to page
	Reference to graphic
	Result of a step

2 Basic safety instructions

2.1 Requirements for 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.
- Measuring point faults may be repaired only by authorized and specially trained personnel.

Repairs not described in the Operating Instructions provided may only be carried out directly by the manufacturer or by the service organization.

2.2 Designated use

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

The specific suitability depends on the sensor design:
- COS22-*1 (standard, measuring range 0.01 to 60 mg/l)
  - Measuring, monitoring and regulating the oxygen content in fermenters
  - Monitoring the oxygen content in biotechnology facilities
- COS22-*3 (trace measurement, measuring range 0.001 to 10 mg/l, preferred operational range 0.001 to 2 mg/l), also suitable for high CO_2 partial pressure
  - Monitoring inertization equipment in the food industry
  - Monitoring the residual oxygen content in carbonated fluids of the beverage industry
  - Trace measurement in industrial applications such as inertizations
  - Monitoring the residual oxygen content in boiler feedwater
  - Monitoring, measuring and regulating the oxygen content in chemical processes

NOTICE

Molecular hydrogen

Hydrogen causes sensitivity in other substances and leads to false low readings or, at the worst, total failure of the sensor.

▶ Only use the COS22-*1/3 sensor in media free of hydrogen.

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 Occupational 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 European 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

1. Before commissioning the entire measuring point, verify that all connections are correct. Ensure that electrical cables and hose connections are undamaged.
2. Do not operate damaged products, and safeguard them to ensure that they are not operated inadvertently. Label the damaged product as defective.
3. If faults cannot be rectified:
   Take the products out of operation and safeguard them to ensure that they are not operated inadvertently.

2.5 Product safety

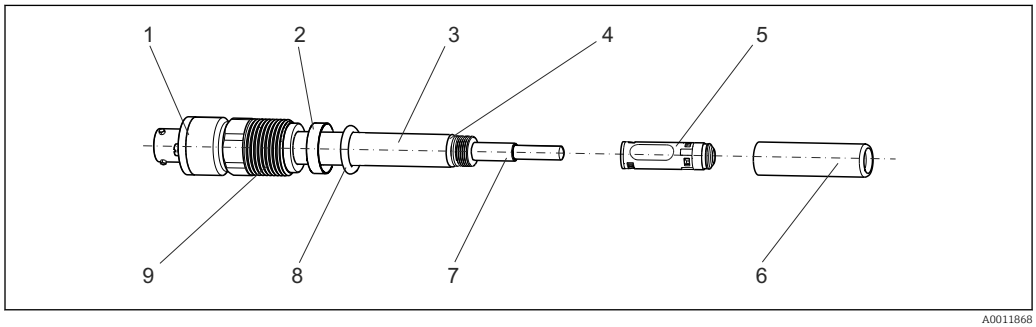
The product is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. The relevant regulations and European standards have been observed.

3 Device description, function

3.1 Amperometric measuring principle

The oxygen molecules that diffuse through the membrane are reduced at the cathode to hydroxide ions (OH-). At the anode, silver is oxidized to silver ions (Ag+) (this forms a silver halide 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, µg/l, ppm, ppb or Vol%, as a saturation index in % SAT or as an oxygen partial pressure in hPa.

3.2 Sensor design



1 COS22

1	*Plug-in head*	*4*	*O-ring 8.5 x 1.5 mm*	*7*	*Glass portion with anode and cathode*
2	*Thrust collar*	*5*	*Membrane body*	*8*	*Process seal 10.77 x 2.62 mm*
3	*Sensor shaft*	*6*	*Shaft sleeve*	*9*	*Process connection Pg 13.5*

3.3 Membrane body

The oxygen dissolved in the medium is transported to the membrane by the necessary flow. The membrane is permeable for dissolved gases only. 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 shipped with a standard membrane body, which can be used for all common applications. The membrane is pretensioned at the factory and can be installed immediately.

Electrolytes are version-specific and **cannot** be mixed in a single application!

3.4 Polarization

When the sensor is connected to the transmitter, a fixed voltage is applied between the cathode and anode. The polarization current this creates can be identified on the transmitter with a display that is initially high, but decreases with time. The sensor cannot be calibrated until the display is calibrated.

Reference value for nearly complete polarization of a sensor that was previously stored for a long time:
- COS22-*1: 2 hours
- COS22-*3: 12 hours

After this time, even measurements close to the determination limit are useful. The necessary polarization time is reduced for sensors that were in use a short time before.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

1. Verify that the packaging is undamaged.
   ↳ Notify your supplier of any damage to the packaging.
   Keep the damaged packaging until the matter has been settled.
2. Verify that the contents are undamaged.
   ↳ Notify your supplier of any damage to the delivery contents.
   Keep the damaged products until the matter has been settled.
3. Check the delivery for completeness.
   ↳ Check it against the delivery papers and 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.
   The permitted ambient conditions must be observed (see "Technical data").

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

4.2 Product identification

4.2.1 Nameplate

The nameplate provides you with the following information on your device:
- Manufacturer identification
- Order code
- Extended order code
- Serial number
- Safety information and warnings

Compare the data on the nameplate with your order.

4.2.2 Product identification

Product page

www.endress.com/cos22

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

Obtaining information on the product

1. Go to the product page for your product on the Internet.
2. In the navigation area on the right-hand side, select "Check your device features" under "Device support".
   ↳ An additional window opens.
3. Enter the order code from the nameplate into the search field.
   ↳ You will receive information on each feature (selected option) of the order code.

4.3 Scope of delivery

The scope of delivery comprises:

- Oxygen sensor with watering cap (filled with tap water) for protecting the membrane
- Electrolyte, 1 bottle, 10 ml (0.34 fl.oz.)
- Tool to push out the membrane body
- Brief Operating Instructions

4.4 Certificates and approvals

4.4.1 CE mark

Declaration of Conformity

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

4.4.2 Material certificates

Manufacturer declaration of FDA compatibility

The manufacturer declares the use of FDA-listed materials.
Ask your Sales Center for the certificates.

Product	FDA certificate for
COS22-****22	Membrane, O-rings, process seal
COS22Z-*2*2	Membrane, O-rings, process seal
COS22-****23	Membrane, O-rings
COS22Z-*2*3	Membrane, O-rings

Material test certificate

A test certificate 3.1 in accordance with EN10204 is supplied depending on the version (→ Product Configurator on the product page).

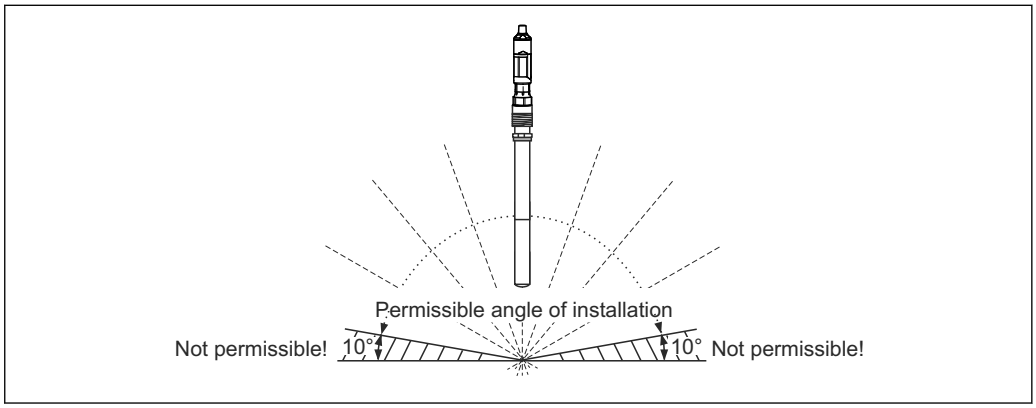
EHEDG

Compliance with EHEDG's criteria for hygienic design
- TÜV Rheinland, Apeldorn, Netherlands
- Certificate type: Type EL Class I

5 Installation

5.1 Installation conditions

5.1.1 Orientation



2 *Permitted orientations*

The sensor must be installed at an angle of inclination of 10 to 170 ° in an assembly, bracket or appropriate process connection. Recommended angle: 45°, to prevent the formation of air bubbles.

Inclination angles other than those mentioned are not permitted. Do **not** install the sensor overhead.

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

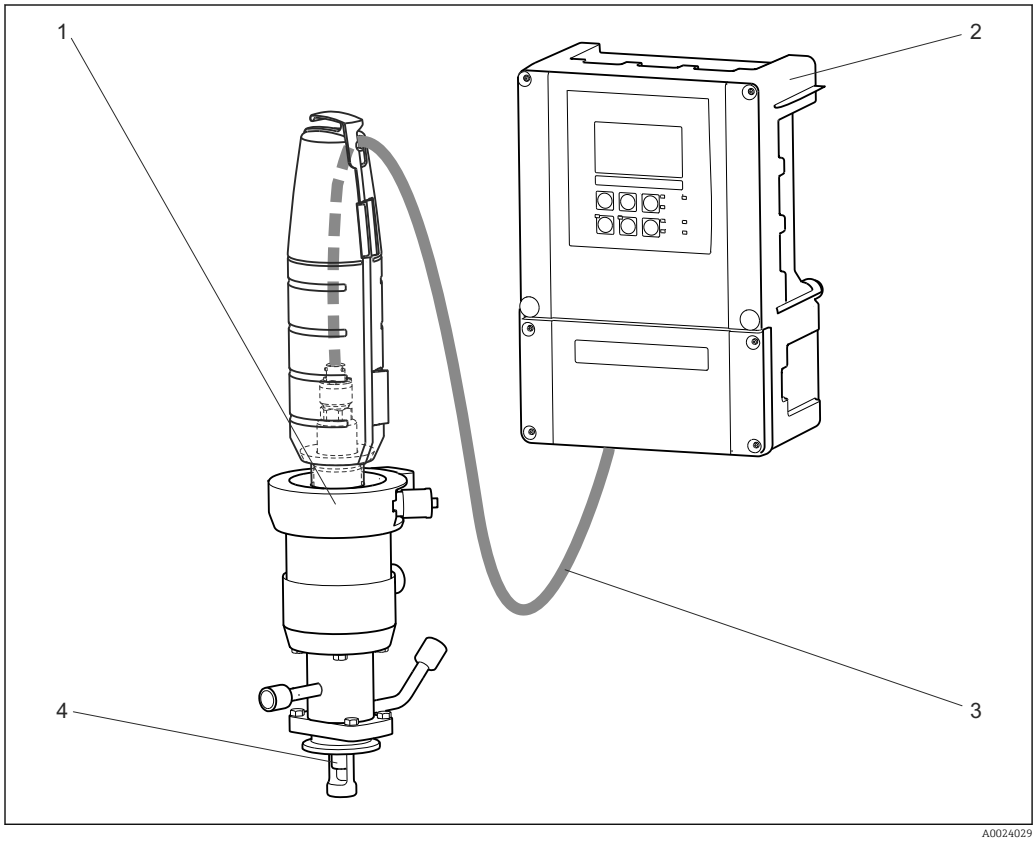
5.1.2 Mounting location

- Choose a mounting location that can be easily accessed at a later stage.
- Ensure that upright posts and fittings are fully secured and vibration-free.
- Select an installation location which produces a typical oxygen concentration for the individual application.

5.2 Mounting the sensor

5.2.1 Measuring system

A complete measuring system comprises:
- An Oxymax COS22 oxygen sensor
- A transmitter, e.g. Liquisys COM2x3
- Measuring cable COK21
- Optional: an assembly, e.g. permanent installation assembly CPA442, flow assembly CPA240, or retractable assembly CPA875



3 *Example of a measuring system with COS22-*1*

1 *Retractable assembly CPA875*
2 *Transmitter Liquisys COM253*
3 *Measuring cable COK21*
4 *Oxygen sensor COS22*

5.2.2 Installing a measuring point

Installation in suitable assembly is required (depending on the application)

WARNING

Electrical voltage

In the event of a fault, non-grounded metallic assemblies may be under voltage and then are not touchable.

► When using metallic assemblies and installation equipment, observe the national grounding provisions.

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.

NOTICE

Installation error

Cable open circuit, loss of sensor due to cable separation, unscrewing of membrane cap

- Do not install the sensor suspended from the cable.
- Screw the sensor into the assembly so that the cable is not twisted.
- When installing or uninstalling the sensor body, hold it tightly. Turn **using only the hexagonal nut** on the armored coupling. Otherwise you might unscrew the membrane cap. This will then remain in the assembly or process.
- Avoid exerting excessive tensile force on the cable (e.g. from jerky pulling).
- Select an installation location that is easy to access for later calibrations.

5.3 Installation examples

5.3.1 Permanent installation (CPA442)

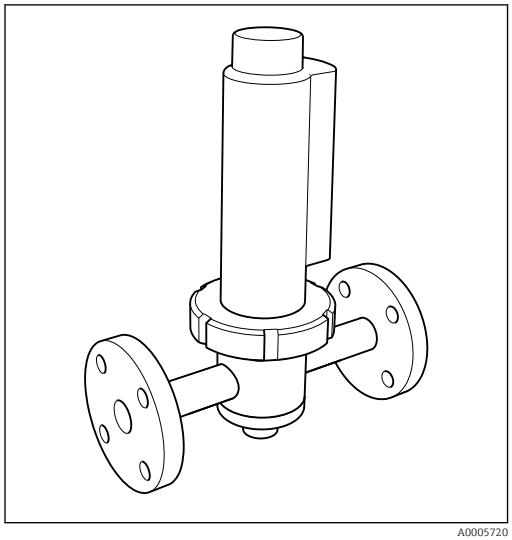
The permanent installation assembly CPA442 enables easy adaptation of a sensor to nearly any process connections from Ingold nozzles to Varivent or Tri-Clamp connections. This kind of installation is very well suited for tanks and larger pipes. You will achieve a defined immersion depth of the sensor into the medium in the simplest way.

5.3.2 Flow assembly

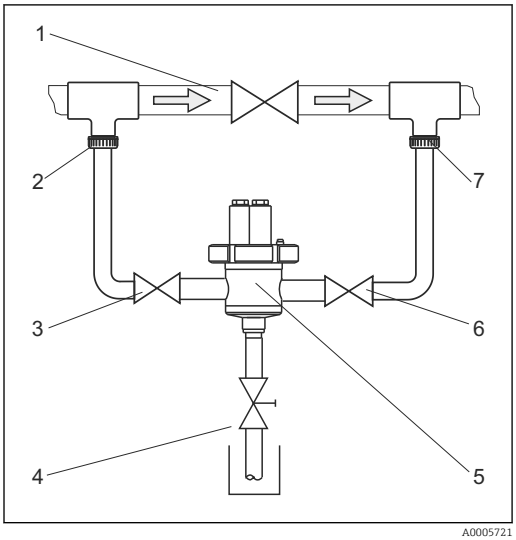
CPA240

The flow assembly CPA240 offers up to three installation spaces for sensors with a shaft diameter of 12 mm (0.47"), a shaft length of 120 mm (4.7"), and a Pg 13.5 process connection. It very well suited for use in pipelines or hose connections. To prevent

measured error with trace measurements, pay particular attention to complete ventilation of the assembly.



4 *Flow assembly CPA240 with protective cover*

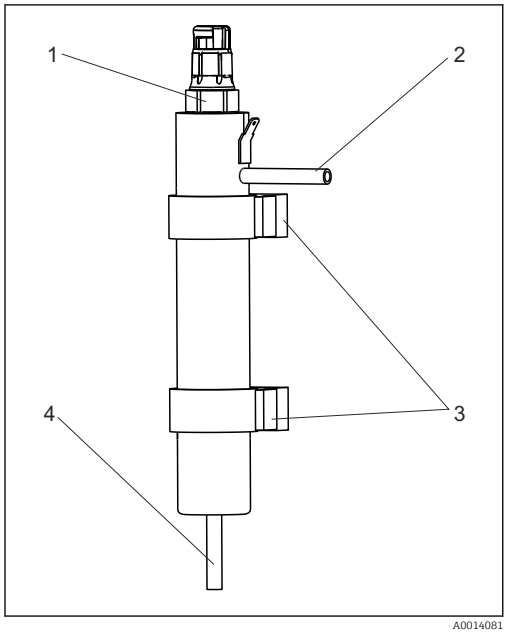


5 *Bypass installation*

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

Flow assembly 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.



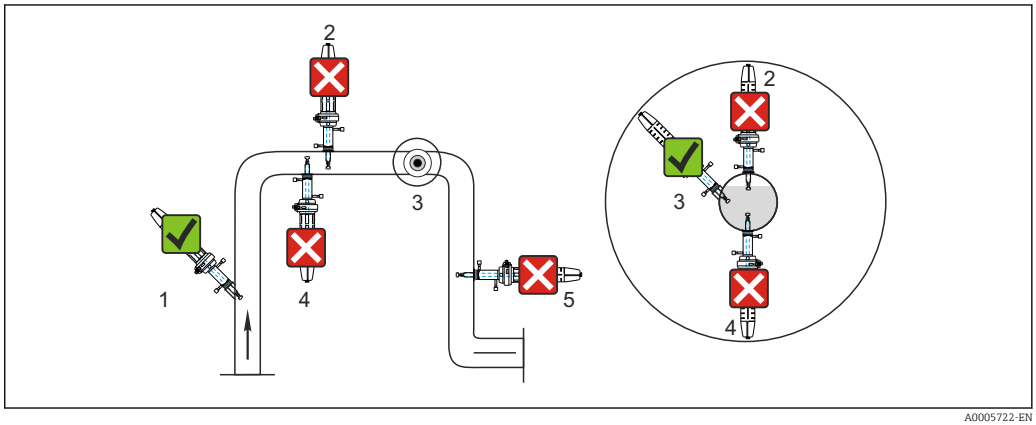
6 *Flow assembly*

1 Built-in sensor
2 Drain
3 Wall mount (clamp D29)
4 Inflow

5.3.3 Retractable assembly (CPA875 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 (3").



7 *Permissible and impermissible sensor installation positions with 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 *Down pipe, impermissible*

NOTICE

Sensor not in the medium all the way, buildup, overhead installation

Results in incorrect measurements

- ▶ Do not install the assembly at places where air cushions or foam bubbles can be formed.
- ▶ Avoid deposits on the sensor membrane, or remove them regularly.
- ▶ Do not install the sensor overhead.

5.4 Post-installation check

- Are the sensor and cable undamaged?
- Is the orientation correct?
- Is the sensor installed in an assembly and is not suspended from the cable?
- Avoid the penetration of moisture by fitting the protective cap to the immersion assembly.

6 Electrical connection

⚠ WARNING

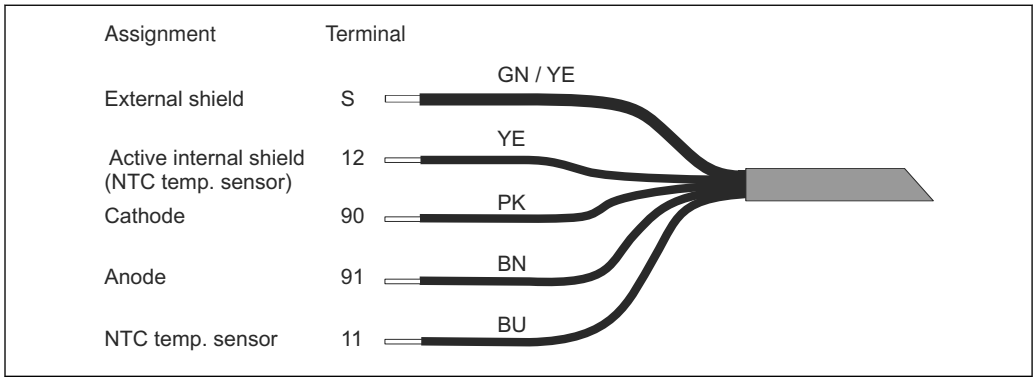
Device is live

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

A multi-core COK21 measuring cable is used for the electrical connection of the sensor to the transmitter.



8 *Measuring cable COK21*

The polarization voltage must be set at the transmitter as follows:
Standard measuring range: -650mV
Trace measuring range: -550mV
The voltage is applied between the working electrode (cathode) and the reference electrode (anode).

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, designated use, may be carried out 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) which are loose or insufficiently secured.

6.3 Post-connection check

Device condition and specifications	Notes
Are the outside of the sensor, assembly, junction box, cable undamaged?	Visual inspection
Electrical connection	**Notes**
Are the installed cables strain-relieved and not twisted?	

Device condition and specifications	Notes
Is a sufficient length of the cable cores stripped, and is it positioned in the terminal correctly?	Check the fit (by pulling gently)
Are all the screws terminals properly tightened?	Tighten
Are all cable entries mounted, tightened and leak-tight?	For lateral cable entries, make sure the cables loop downwards to allow water to drip off
Are all cable entries installed downwards or mounted laterally?	

7 Calibration and adjustment

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

Calibration of the sensor is required after:
- Initial commissioning
- Changing the membrane or electrolyte
- Long pauses 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.

7.1 Types of calibration

You can carry out a slope or zero point calibration for the sensor.

In most applications, single-point calibration in the presence of oxygen is sufficient (=calibration of the sensor slope). When switching from process to calibration conditions, you have to allow a longer settling time for the sensor.

The additional calibration of the zero point improves the accuracy of the measurement results at trace concentrations. You can calibrate the zero point using nitrogen (min. 99.995%) or oxygen-free water. Make sure that the sensor is polarized and the measured value is settled at the zero point (at least 20-30 minutes) to prevent later incorrect measurements at trace concentrations.

The following describes calibration of the slope in air (saturated with water vapor) as the easiest and recommended calibration method. However, this type of calibration is possible only if the air temperature is ≥ 0 °C (32 °F).

7.2 Calibration in air

1. Remove the sensor from the medium.
2. Clean the outside of the sensor with a damp cloth.
3. Allow approx. 20 minutes for the sensor temperature to adapt to the ambient air. Make sure that the sensor is not exposed to any direct ambient influences (direct sunlight, drafts) during this time.
4. When the measured value display on the transmitter is stable, carry out the calibration according to the operating instructions for the transmitter. Pay particular attention to the software settings for the stability criteria for calibration.
5. Where necessary:
   Adjust the sensor.
6. Then insert the sensor into the medium.

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

7.3 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 sensor temperature (air temperature for the calibration type "air", water temperature for the calibration type "air-saturated water")
   - 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 in H_2O)).
2. Define:
   - 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

Altitude [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 the factor **L:**

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

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, current air pressure 1009 hPa (405 in H_2O)
- S = 9.45 mg/l, K = 0.943, L = 0.996
- Calibration value C = 8.88 mg/l.

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

7.4 Zero point calibration

The zero point is not so important when working with relatively high concentrations of oxygen.

This situation changes, however, once oxygen sensors are used at low concentrations and in the trace range and where they are also to be calibrated in the zero point. Zero point calibrations are demanding as the ambient medium - usually air - already has a high oxygen content. This oxygen must be blocked off for zero-point calibration of the sensor.

Calibration with zero-point gel can be used here:
The oxygen-depleting gel COY8 (→ 🖹 26) creates an oxygen-free medium for zero point calibration.

Prior to sensor zero point calibration, check:
- Is the sensor signal stable?
- Is the value displayed plausible?

1. If the sensor signal is stable:
   Calibrate the zero point.
2. If necessary:
   Adjust the sensor to the zero point.

The reference method (sample calibration in zero point) can also be used here if appropriate collecting vessels or reference measurement are available.

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

Rule of thumb: Operate the sensor in zero-point gel for at least 0.5 h.

If the sensor was already operated in the trace range before the zero point calibration, the time specified above generally suffices. If the sensor was operated in air, significantly more time must be factored in to also remove residual oxygen from any dead volume inherent to the design. Here a value of 2 hours applies as a general rule.

8 Commissioning

8.1 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 that the cleaning medium (e.g. water or air) is connected correctly.

⚠ WARNING

Escaping process medium

Risk of injury from high pressure, high temperatures or chemical hazards
- ▶ Before applying compressed air to an assembly with cleaning facility, make sure the connections are correctly fitted.
- ▶ Do not install the assembly in the process if you cannot make the correct connection reliably.

8.2 Sensor polarization

NOTICE

Incorrect measurements due to ambient influences
- ▶ Be absolutely certain to avoid direct sunlight on the sensor.
- ▶ Make sure you comply with the instructions for commissioning in the Operating Instructions of the transmitter.

The sensor has been tested at the factory for proper function and is shipped in ready-to-operate condition.

To prepare for the calibration, carry out the following steps:

1. Pull off the sensor protection cap.
2. Expose the sensor, which should be dry on the outside, to the air atmosphere.
   ↳ The air should be saturated with water vapor. Therefore, install the sensor as close as possible to a surface of water. However, the sensor membrane must remain dry during calibration. Therefore, avoid direct contact with the surface of water.
3. Connect the sensor to the transmitter.
4. Switch on the transmitter.
   ↳ When the sensor is connected to the transmitter, the polarization takes place automatically after the power-up of the transmitter.
5. Wait for the polarization time to run out.

8.3 Sensor calibration

Calibrate the sensor (e.g. air calibration) immediately after the polarization time runs out.

The calibration intervals depend greatly on:
- The application
- The installation position of the sensor

The following method helps you determine the necessary calibration intervals:

1. Inspect the sensor one month after commissioning. Take it out of the medium and dry it.
2. After 10 minutes, measure the oxygen saturation index in air.
   ↳ Decide depending on the result: If the measured value is not 100 ±2 %SAT, you must calibrate the sensor. Otherwise, double the length of time to the next inspection.
3. 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.

In any case, calibrate the sensor at least once a year.

9 Troubleshooting

If one of the following problems is present, check the measuring system in the sequence listed here.

Problem	Testing	Remedial action
No display, no sensor reaction	Power supply to the transmitter?	Connect the power supply
	Sensor cable connected correctly?	Set up correct connection.
	Medium flow present?	Create medium flow
	Coating on the membrane?	Clean sensor
	No electrolyte in the measuring chamber?	Refill or change electrolyte
Displayed value too high	Polarization ended?	Wait for polarization time to finish
	Is sensor calibrated/adjusted?	recalibrate/readjust
	Displayed temperature clearly too low?	Check sensor, if necessary send sensor in for repair.
	Membrane visibly stretched?	Replacing the membrane cap
	Electrolyte dirty?	Electrolyte replacement
	Open the sensor and dry the electrode. Is the transmitter display now at 0?	Check the cable connection. If the problem persists, send in the sensor.
Displayed value too low	Is sensor calibrated/adjusted?	recalibrate/readjust
	Medium flow present?	Create medium flow
	Displayed temperature clearly too high?	Check sensor, if necessary send sensor in for repair.
	Coating on the membrane?	Clean sensor
	Electrolyte dirty?	Electrolyte replacement
Display value fluctuating greatly	Membrane visibly stretched?	Replacing the membrane cap
	Open the sensor and dry the electrode. Is the transmitter display now at 0?	Check the cable connection. If the problem persists, send in the sensor.

Please observe the troubleshooting information in the Operating Instructions for the transmitter. If need be, carry out a test on the transmitter.

10 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, take into account possible repercussions for process control or 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.

10.1 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 (1/2 year)
- Greatly varying conditions, e.g. daily CIP cleaning = short cycles (1 month or shorter)

The following method helps you determine the necessary intervals:

1. Inspect the sensor one month after commissioning. Take it out of the medium and dry it.
2. After 10 minutes, measure the oxygen saturation index in air.
   ↳ Decide depending on the result: If the measured value is not 100 ±2 %SAT, you must maintain the sensor. Otherwise, double the length of time to the next inspection.
3. Proceed as per Point 1 after two, four and/or eight months. In this way, you can determine the optimum maintenance interval for your sensor.

Particularly in the case of widely fluctuating process conditions, damage may occur to the membrane even within a maintenance cycle. You can recognize this by implausible sensor behavior.

10.2 Maintenance tasks

The following tasks are mandatory:
- Clean the sensor and the glass body with anode and cathode (particularly if membrane is dirty)
- Replacement of wear parts or consumables:
  – Electrolyte
  – Membrane body
  –
  – Sealing ring
- 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 100 ± 2 % SAT.
- Recalibration (if desired or required)

10.3 Clean sensor

The measurement can be corrupted by sensor fouling or malfunction, e.g.:
- Buildup on the sensor membrane
- ↳ causes longer response times and a reduced slope under certain circumstances.

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

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

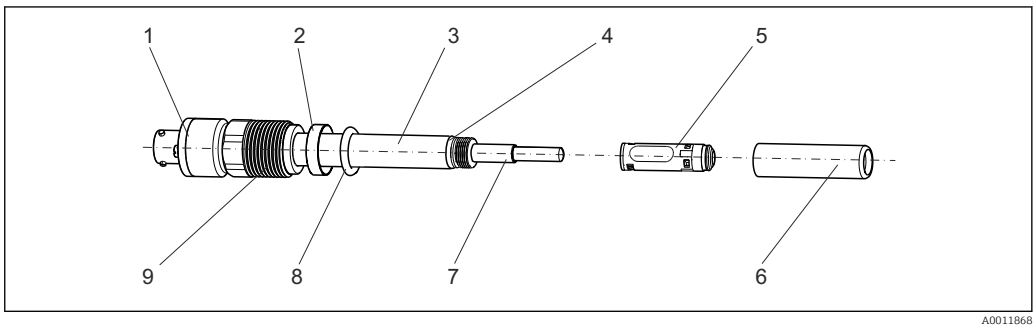
Type of soiling	Cleaning
Salt deposits	Immerse the sensor in drinking water or in 1-5% hydrochloric acid (for a few minutes). Afterwards, rinse it with copious amounts of water.
Dirt particles on the sensor shaft and shaft sleeve (**not membrane!**)	Clean the sensor shaft and sleeve with water and a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

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

10.4 Wear parts and consumables

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

Measure	Reason
Sealing ring replacement	Visible damage to a sealing ring
Electrolyte replacement	Unstable or implausible measuring signal or fouling of the electrolyte
Membrane body replacement	Membrane is damaged or can no longer be cleaned (hole or overstretching)



9 COS22

1	*Plug-in head*	*4*	*O-ring 8.5 x 1.5 mm*	*7*	*Glass portion with anode and cathode*
2	*Thrust collar*	*5*	*Membrane body*	*8*	*Process seal 10.77 x 2.62 mm*
3	*Sensor shaft*	*6*	*Shaft sleeve*	*9*	*Process connection Pg 13.5*

10.4.1 Replacing sealing rings

The sealing ring must be replaced if visibly damaged. For replacement, use only original sealing rings.

The following O-rings can be replaced:
- Sealing ring for shaft sleeve: item 4 → 📄 23
- Sealing ring for process: item 8

If the sealing ring on the membrane body (item 5) is damaged, you must replace the entire membrane body.

10.4.2 Replacing electrolyte

The electrolyte is used up slowly during operation. This is caused by electrochemical substance reactions. In de-energized state, no substance reactions take place, and the electrolyte is not used up. The operating time of the electrolyte is shortened by diffusion of dissolved gases such as H_2S, NH_3 or high concentrations of CO_2.

Theoretical operating time at p_{O2} = 210 mbar and T=25 °C (77 °F)

COS22-*1 (standard sensor):	> 1.5 years
COS22-*3 (trace sensor):	> 3 months

⚠ CAUTION

The standard electrolyte is a strong irritant

Danger of severe skin and eye irritation

- ▶ Be absolutely certain to observe the corresponding workplace safety regulations.
- ▶ Wear protective clothing, gloves and goggles when handling the electrolyte.
- ▶ In case of eye contact: Remove contact lenses, flush eyes with water for a few minutes and contact a doctor.
- ▶ In case of skin contact: Take off wet clothing immediately, wash the skin or take a shower.

Generally, the following applies:
- Changing the electrolyte is mandatory if the membrane body is detached.
- Sensors operated close to the zero point consume hardly any chemical electrolyte. The electrolyte does not have to be replaced for a long period.
- Sensors operated at high partial oxygen pressures (> 100 hPa) consume a significant amount of electrolyte. The electrolyte has to be replaced frequently.
- 25 ml electrolyte are enough to fill the membrane body approx. 15 times.

Draining the electrolyte

1. Remove the sensor from the medium.
2. Clean the outside of the sensor.
3. Hold the sensor vertically and unscrew the shaft sleeve.
   ↳ The membrane body is either in the shaft sleeve or is still on the glass portion with the anode and cathode.
4. Remove the membrane body. For this purpose, use the tool provided to push out the membrane body.
5. Drain the membrane body and flush it with potable water.

Top up the electrolyte and install the membrane body

1. Fill fresh electrolyte from the supply bottle into the membrane body.
2. Remove all air bubbles from the electrolyte by tapping the side of the membrane body (using a pen or pencil, for example).
3. Hold the sensor vertically and carefully push the membrane body, filled with electrolyte, on the glass portion.

4. Carefully screw on the shaft sleeve as far as it will go.

After replacing, the sensor must be repolarized and recalibrated. Then insert the sensor into the medium and check that no alarm is displayed on the transmitter.

10.4.3 Replacing membrane body

Removing the membrane body

1. Remove the sensor from the medium.
2. Clean the outside of the sensor.
3. Hold the sensor vertically and unscrew the shaft sleeve.
   ↳ The membrane body is either in the shaft sleeve or is still on the glass portion with the anode and cathode.
4. Remove the membrane body. For this purpose, use the tool provided to push out the membrane body.
5. Dispose of the old membrane body and the old electrolyte.
6. Take a **new** membrane body out of its packaging.

Top up the electrolyte and install the membrane body

1. Fill fresh electrolyte from the supply bottle into the membrane body.
2. Remove all air bubbles from the electrolyte by tapping the side of the membrane body (using a pen or pencil, for example).
3. Hold the sensor vertically and carefully push the membrane body, filled with electrolyte, on the glass portion.
4. Carefully screw on the shaft sleeve as far as it will go.

After replacing, the sensor must be repolarized and recalibrated. Then insert the sensor into the medium and check that no alarm is displayed on the transmitter.

10.4.4 Replacing glass body with cathode

NOTICE

Polishing the cathode can cause impaired function or total failure of the sensor.

▶ Do not clean the cathode mechanically.

If the cathode is coated, replace the glass body:

1. Hold the sensor vertically and unscrew the shaft sleeve: item 6 .
2. If the membrane body (item 5) remains on the glass body (item 7) and not in the shaft sleeve, remove it from the glass body.
3. Flush the glass body, along with the anode and cathode, using distilled water.
4. Pull the used glass body out of the holder.
5. Dry the inside of the electrode holder.
6. Plug a new glass body (from the membrane kit) into the holder so that it fits. Ensure that you do not damage the electrical contact pins.
7. Fill the membrane body with electrolyte then screw the shaft sleeve back on.

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 office.

11.1 Assemblies (selection)

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

Technical Information TI01168C

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

Technical Information TI00179C

Unifit CPA442
- Installation assembly for food, biotechnology and pharmaceutics
- With EHEDG and 3A certificate
- Product Configurator on the product page: www.endress.com/cpa442

Technical Information TI00306C

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

Technical Information TI00183C

Flow assembly
- For sensors with Ø 12 mm and length 120 mm
- Compact stainless steel assembly with low sampling volume
- Order No. Order No.: 71042404

11.2 Measuring cable

11.2.1 Cable for COS22

COK21
- Cable length 3 m (9.8 ft)
  Order No. 51505870
- Cable length 10 m (33 ft)
  Order No. 51505868

11.3 Zero-point gel

COY8
Zero-point gel for oxygen sensors
- Oxygen-depleting gel for test purposes
- Product Configurator on the product page: www.endress.com/coy8

Technical Information TI01244C

11.4 Maintenance kit

COS22Z

- Service Kit, COS22 and COS22D
- Ordering information: www.endress.com/cos22d under "Accessories/spare parts"

12 Repair

12.1 Spare parts and consumables

COS22Z
- Service Kit, COS22 and COS22D
- Ordering information: www.endress.com/cos22d under "Accessories/spare parts"

12.2 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 swift, safe and professional device returns, please read the return procedures and conditions at www.endress.com/support/return-material.

12.3 Disposal

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

Observe the local regulations.

13 Technical data

13.1 Input

Measured values

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

Temperature [°C, °F]

Measuring ranges

Measuring ranges apply for 20 ° (68 °F) and 1013 hPa (15 psi)

	Measuring range	Optimum operational range [1]
COS22-*1	0.01 to 60 mg/l 0 to 600 % SAT 0 to 1200 hPa (0 to 6 psi) 0 to 100 Vol%	0.01 to 20 mg/l 0 to 200 % SAT 0 to 400 hPa (0 to 6 psi) 0 to 40 Vol%
COS22-*3	0.001 to 10 mg/l 0 to 120 % SAT 0 to 250 hPa (0 to 6 psi) 0 to 25 Vol%	0.001 to 2 mg/l 0 to 20 % SAT 0 to 40 hPa (0 to 6 psi) 0 to 4 Vol%

1) Applications in this range guarantee a long service life and minimum maintenance

13.2 Performance characteristics

Response time

From air to nitrogen at reference operating conditions:
- 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: Air-saturated water

Signal current in air

COS22-*1 (standard sensor): 40 to 100 nA
COS22-*3 (trace sensor): 210 to 451 nA

Zero current

COS22-*1 (standard sensor): < 0.1 % of the signal current in air
COS22-*3 (trace sensor): < 0.03 % of the signal current in air

Measured value resolution

COS22-*1 (standard sensor): 10 ppb in aqueous, 0.2 hPa or 0.02 Vol% in gaseous media
COS22-*3 (trace sensor): 1 ppb in aqueous, 0.02 hPa or 0.002 Vol% in gaseous media

Corresponds to the recommended measured value resolution at the transmitter

Maximum measured error

COS22-*1 (standard sensor): ≤ ±1 % of measuring range + 10 ppb *
COS22-*3 (trace sensor): ≤ ±1 % of measuring range + 1 ppb *
* at reference operating conditions

Long-term drift	< 4 % per month in reference operating conditions ≤ 1 % per month in operation with reduced oxygen concentration (< 4 Vol% O_2)	
Influence of the medium pressure	Pressure compensation not required	
Polarization time	COS22-*1 (standard sensor):	< 30 min for 98% signal value, 2 h for 100%
	COS22-*3 (trace sensor):	< 3 h for 98% signal value, 12 h for 100%
Intrinsic oxygen consumption	COS22-*1 (standard sensor):	Approx. 20 ng/h in air at 25 °C (77 °F)
	COS22-*3 (trace sensor):	Approx. 100 ng/h in air at 25 °C (77 °F
Operating time of the electrolyte	→ 📄 24	
Temperature compensation	**COS22** Compensation of the membrane properties depending on the transmitter, recommended: 2.4 % per K	

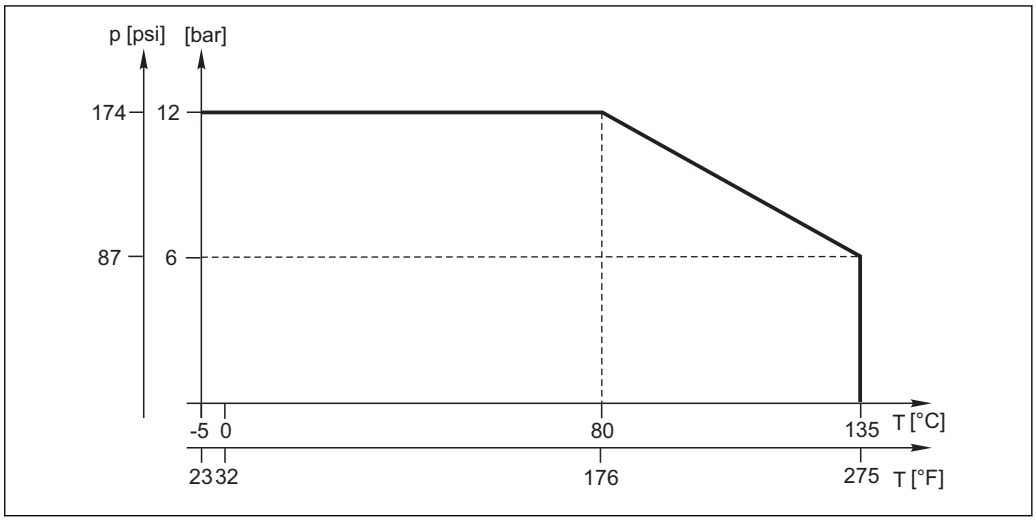
13.3 Environment

Ambient temperature range	-5 to +135 °C (23 to 275 °F), non-freezing
Storage temperature	–5 to +50 °C (20 to 120 °F) at 95% relative humidity, non-condensing **NOTICE** **Danger of sensor drying out** ► Store the sensor with the watering cap only (filled with tap water).
Degree of protection	IP 68 (10 m (33 ft) head of water at 25 °C (77 °F) over 45 days, 1 mol/l KCl)
Humidity	0 to 100%, not condensating in area of T-82 connection

13.4 Process

Process temperature	-5 to +135 °C (23 to 275 °F), non-freezing
Process pressure	Ambient pressure ... 12 bar (... 174 psi) absolute

Temperature-pressure ratings



Minimum flow	COS22-*1 (standard sensor):	0.02 m/s (0.07 ft/s)
	COS22-*3 (trace sensor):	0.1 m/s (0.33 ft/s)

Chemical resistance

Parts in contact with the medium are chemically resistant to:
- Diluted acids and alkalis
- Hot water and superheated steam up to max. 135 °C (275 °F)
- CO_2 up to 100 %, only with trace sensor COS22-*3

NOTICE

Hydrogen sulfide and ammonia shorten the operating life of the sensor.
- ▶ Do not use the sensor in applications where it is exposed to hydrogen sulfide or ammonia vapors.

Cross-sensitivity

COS22-*1/3

Molecular hydrogen causes false low readings and can, in a worst-case scenario, result in total failure of the sensor.

CIP compatibility

Yes (COS22-*1/3)

SIP compatibility

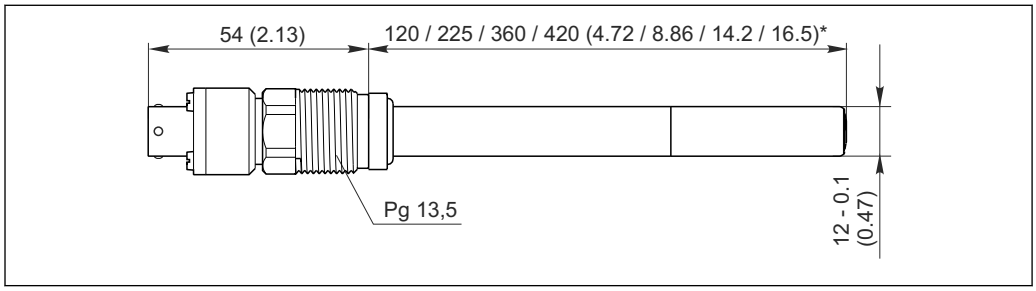
Yes, max. 140 °C (284 °F) (COS22-*1/3)

Autoclavability

Yes, max. 140 °C (284 °F), max. 30 min. (COS22-*1/3)

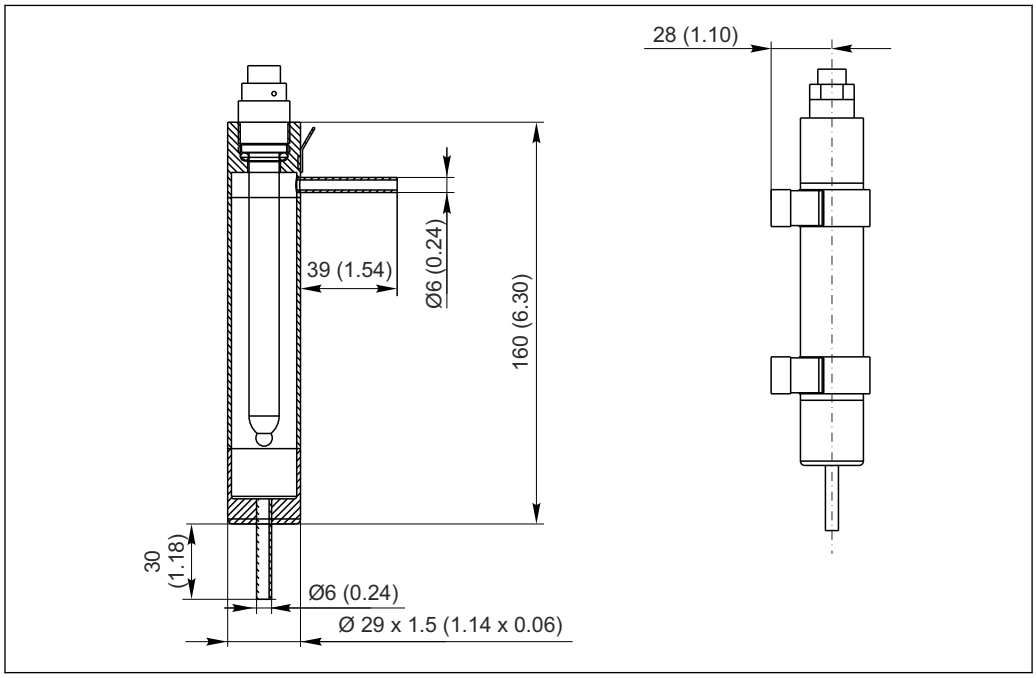
13.5 Mechanical construction

Dimensions



10 Dimensions in mm (inch)

Flow assembly for sensors with Ø 12 mm (accessories)



11 Dimensions in mm (inch)

Weight

Depending on the design (length)
0.2 kg (0.44 lbs) to 0.7 kg (1.54 lbs)

Materials

Parts in contact with medium

Sensor shaft (depending on the version)	Stainless steel 1.4435 (AISI 316L) Titanium Alloy C22
Electrode combination	COS22-*1/3: silver / platinum
Process seal	VITON (FDA-compliant)
Process seal for ATEX/FM/CSA/NEPSI/TIIS	VITON (not FDA-compliant)
Seals/O-rings	VITON (FDA-compliant)
Membrane body, sealing ring for shaft sleeve	Perfluoroelastomer with USP88 Class VI
Membrane	Silicone (FDA-compliant, in compliance with USP87/88 class VI), PTFE, steel mesh

Process connection

Pg 13.5

Surface roughness	R_a < 0.38 µm	
Temperature sensor	NTC 22 kΩ	
Electrolyte	COS22-*1 (standard sensor): COS22-*3 (trace sensor):	Slightly alkaline electrolyte Neutral electrolyte

Index

S

T

U

W

Z

www.addresses.endress.com

Endress+Hauser

People for Process Automation