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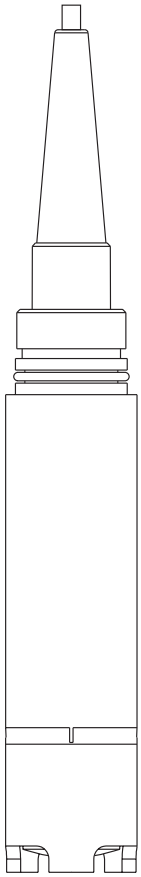
COS 4 / COS 4HD
Sensor for Dissolved Oxygen

Operating Instructions



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1 General information

1.1 Symbols used

Warning:

This symbol alerts to hazards which may cause serious injuries as well as damage.

Caution:

This symbol alerts to possible malfunctions due to operator error.

Note:

This symbol indicates important items of information.

1.2 Safety notes

Warning:

- The notes and warnings in these operating instructions must be strictly adhered to!
- Faults on the assembly may only be remedied by authorised and properly trained personnel.

2 Description

The oxygen sensor COS 4 / COS 4HD is intended for continuous measurement of oxygen dissolved in water.

Typical applications are, for example:
- Measurement of O_2 content in activated sludge basins. Here, the measuring signal is used for monitoring and as a control parameter.
- Checking of O_2 concentration in sewage treatment plant effluent.
- Monitoring of public waters, e.g. rivers, lakes, storage lakes.
- Measurement and control of O_2 content in sweet water or salt water fish ponds and fish farms.
- Enrichment of drinking water with O_2.

2.1 Scope of supply

The scope of supply comprises:
- 1 oxygen sensor COS 4 / COS 4HD with permanently attached 7 m or 15 m cable
- 1 shipping cap for membrane protection
- 1 threaded protection guard for measuring operation (screwed onto the sensor)
- 1 spare replacement cartridge COY 3-WP
- 10 plastic ampoules with filling electrolyte COY 3-F (for COS 4) or COY 3HD-F (for COS 4HD)
- 1 copy of operating instructions for COS 4 / COS 4HD.

2.2 Product structure

Oxygen sensor COS 4 / COS 4HD

Cable length
2 7 m
4 15 m

COS 4- ☐ ⇐ **complete order code**

or

COS 4HD- ☐ ⇐ **complete order code**

2.3 Measuring system

The complete measuring system consists of:
- Oxygen sensor COS 4 with transmitter Liquisys COM 221 / 252 or Liquisys S COM 223 / 253
  or
  oxygen sensor COS 4HD with transmitter Liquisys S COM 223 / 253
- Universal suspension assembly holder CYH 101 for immersion operation
- Immersion assembly COA 110 or CYA 611 or flow assembly COA 250 or retractable assembly Probfit COA 461
- Corresponding mounting accessories.

Additionally recommended under extreme operating conditions:
- Automatic spray cleaning system Chemoclean.

The sensor versions differ as follows:
- **COS 4**
  For applications with low to medium load regarding H_2S or NH_3.
  Spare parts: Membrane cap COY 3-WP and filling electrolyte COY 3-F.
  Marking: without colour ring.
- **COS 4HD**
  For applications with high load regarding H_2S or NH_3.
  Spare parts: Membrane cap COY 3-WP and filling electrolyte COY 3HD-F.
  Marking: red colour ring.

3 Design and function

3.1 Design

The sensor consists of the following function units (see fig. 3.1 and 3.2):
- Sensor body and electrode section with gold cathode and anode
- Membrane cap with electrolyte
- Protection guard.

The connecting cable (1), supplied in lengths of 7 m or 15 m, is permanently attached to the sensor body. For simple installation in immersion or flow assemblies, the sensor is equipped with an NPT ¾" (2) or G 1 thread (3).

The sensor body (4) is permanently attached to the electrode section.

The thread in the bottom is used to screw on the protection guard (11) or spray head COR 3 (option) when the sensor is immersed in the medium and equipped with the cleaning function.

The measuring signal proportional to the oxygen content is generated in an electrolyte-filled measuring chamber sealed off towards the outside by a membrane cap (10). The measuring chamber holds a working electrode (8) made of gold and an anode (7) made of silver/silver bromide (COS 4) or silver/silver chloride (COS 4HD).

A bayonet lock with a thrust ring (5) and trapezoid seal (6) provides a high-resistance seal between the measuring chamber and the medium. The membrane cap holds a membrane pretensioned at the factory and therefore permits easy replacement without need for tools.

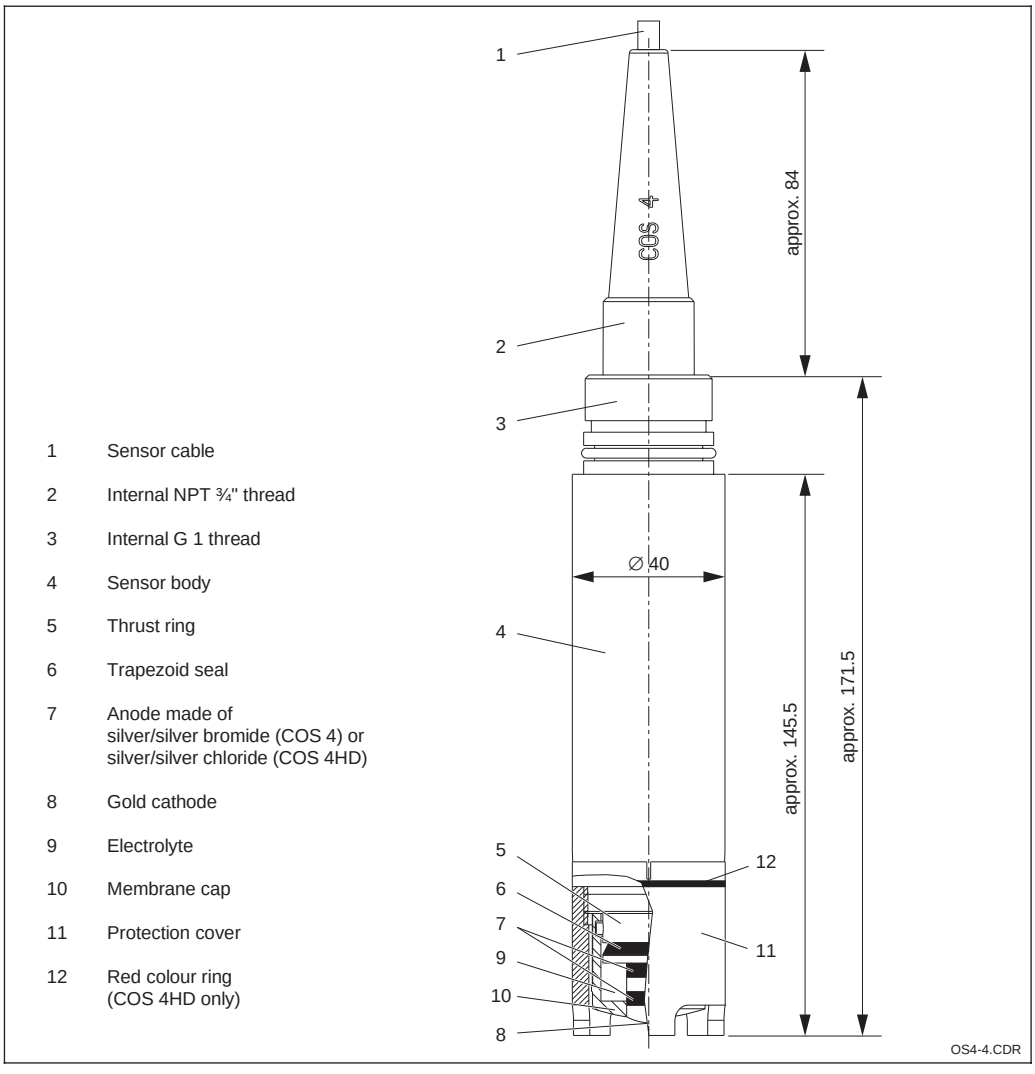


Fig. 3.1 Oxygen sensor COS 4 / COS 4HD

3.2 Function

Polarisation

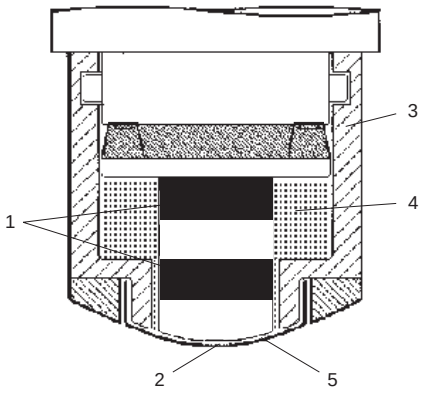
When the sensor is connected to the corresponding transmitter, a fixed external voltage is applied between the cathode and the anode. The polarisation current that flows for this reason is indicated on the transmitter by an initially very high display value which drops off over time. Calibration can only take place after complete polarisation.

Membrane

Oxygen is present in the medium as a physically dissolved gas and is transported towards the membrane by the medium flow required for this measuring principle. Due to the materials used in the membrane and the way in which the membrane is made, only dissolved gases can pass through it but no liquid constituents. Dissolved salts and ionic substances are also held back; this explains why (contrary to the open measuring principle) the conductivity of the medium does not affect the measuring signal in the case of the membrane-covered sensor.

Amperometric measuring principle

The oxygen molecules diffused through the membrane are reduced to hydroxide ions (OH^-) at the gold cathode. At the anode, silver is oxidised to silver bromide (COS 4) or silver chloride (COS 4HD). The resulting electron release at the gold cathode and electron acceptance at the anode produce a current flow that is proportional to the external oxygen concentration in the medium under constant conditions. The current flow is converted in the measuring instrument and indicated on the display as the dissolved oxygen content in mg/l or oxygen saturation index in % SAT.



1 Anode (Ag/AgBr for COS 4, Ag/AgCl for COS 4HD)

2 Cathode (Au)

3 Membrane cap with bayonet lock

4 Electrolyte

5 “Elephant skin” membrane

COS3.CDR

Fig. 3.2 Measuring chamber of oxygen sensor COS 4 / COS 4HD

4 Installation

4.1 General installation notes

The sensor is equipped with an internal NPT ¾" or G 1 thread (see fig. 3.1) and may be used either for immersion or for flow installation in conjunction with the appropriate assembly. Please observe the following notes:

Caution:

To avoid tress building (clogging of the sensor, e.g. with rest of plants) and the following measured errors, you must not fix the sensor only at the cable.

Sensor mounting position

The sensor should always be installed upright, with the membrane at the bottom unless this is not possible for some specific reason. Deviations from this mounting position up to horizontal installation (but no further) are permissible in the case of unfavourable flow conditions. The membrane must never be on top!

Sensor removal and installation

Please make sure the connecting cable turns freely with the sensor and is not twisted when unscrewing or installing the sensor. High tensile forces on the cable, e.g. from abrupt pulling, are to be avoided.

Preassembly

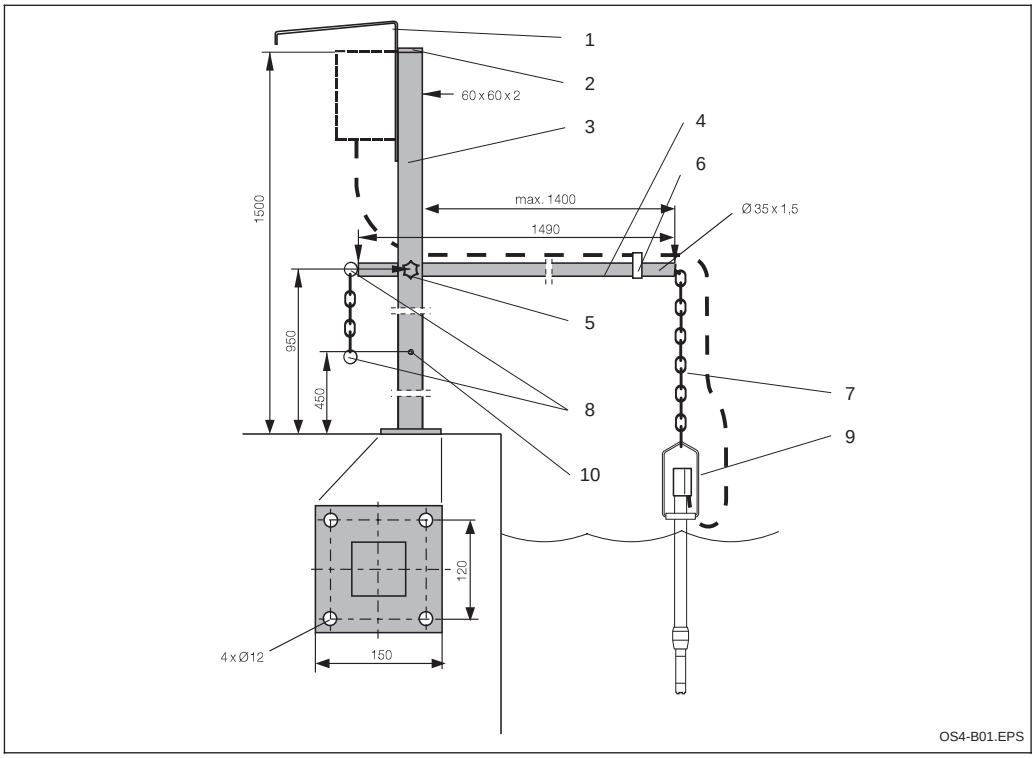
Immersed installation: For safety reasons, the individual assemblies should be pre-assembled on solid ground outside the basin or tank. Only perform the final assembly at the place of installation.

Placement

The place of assembly installation is to be chosen such as to assure good accessibility for calibration. Sturdy and vibration-free installation of upright posts and assemblies is to be assured. For immersion operating in activated sludge tanks you must select a typical place for oxygen concentration to install the sensor.

Shock hazard protection

Observe national grounding regulations for metallic upright posts and assemblies.



Universal suspension assembly holder CYH 101-A with pendulum immersion assembly CYA 611

1 Weather protection cover
2 Plug
3 Upright post, square tube of stainless steel 1.4301 (AISI 304)
4 Transverse pipe of stainless steel 1.4301 (AISI 304)
5 Star handle
6 Velcro strap
7 Plastic chain, length 5 m
8 Plastic shackle
9 Immersion assembly CYA 611, not supplied with CYH 101-A
10 Second attachment position for transverse pipe

Fig. 4.1

4.2 Immersed installation

Upright post and chain assembly

Construction: Universal suspension assembly holder CYH 101-A (see fig. 4.1) in conjunction with pendulum immersion assembly CYA 611. This type of installation should be chosen for larger basins where an adequate distance between the sensor and basin wall is assured. Vibration of the upright post is virtually impossible due to the pendulous suspension of the immersion assembly.

Upright post and fixed immersion tube

Construction: Universal suspension assembly holder CYH 101-D (immersion tube length 2 m, see fig. 4.2) or CYH 101-E (immersion tube length 3.5 m, see fig. 4.2). Preferable type of mounting for flow rates above 0.5 m/s or turbulent flow in basins or for installation in open channels.

A second transverse pipe with a holder of its own should be installed in pos. 10 in the case of very high flow rates or considerable turbulence.

Accessories

- Weather protection cover CYY 101
- Automatic cleaning system Chemoclean CYR 10 / CYR 20
- Spray head COR 3

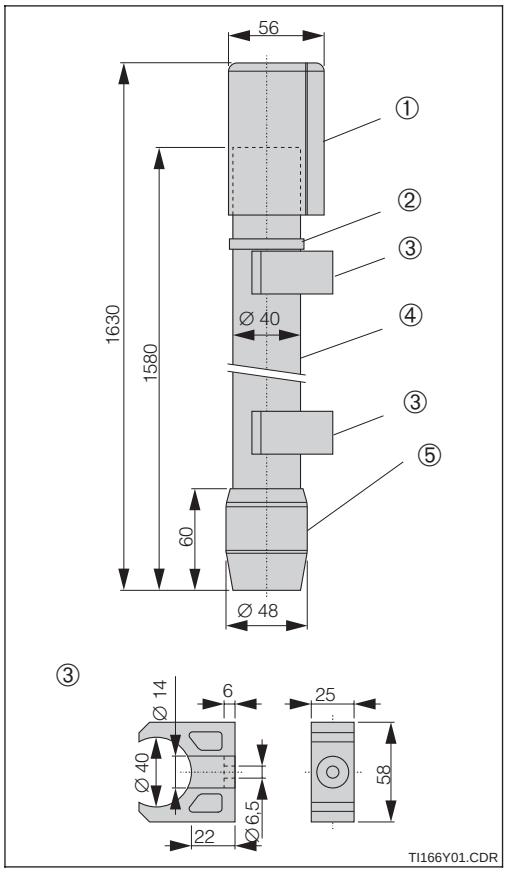


Fig. 4.2 CYA 611: Components and dimensions
① Protection cap
② Worm drive hose clip
③ Pipe clamps
④ PVC pipe
⑤ Threaded coupling

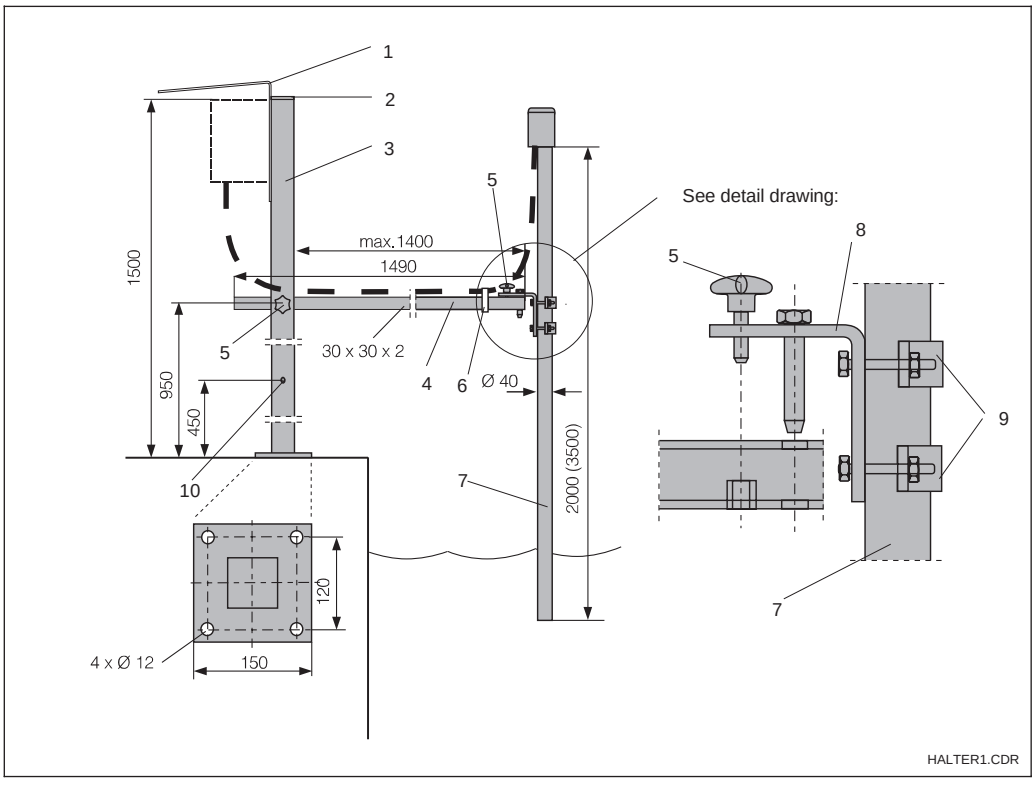


Fig. 4.3 Universal suspension assembly holder CYH 101-D or -E

1 Weather protection cover
2 Plug
3 Upright post, square tube of stainless steel 1.4301 (AISI 304)
4 Transverse pipe of stainless steel 1.4301 (AISI 304)
5 Star handle
6 Velcro strap
7 Immersion tube of stainless steel 1.4301 (AISI 304)
8 Tube holder
9 Mounting bracket
10 Second attachment position for transverse pipe

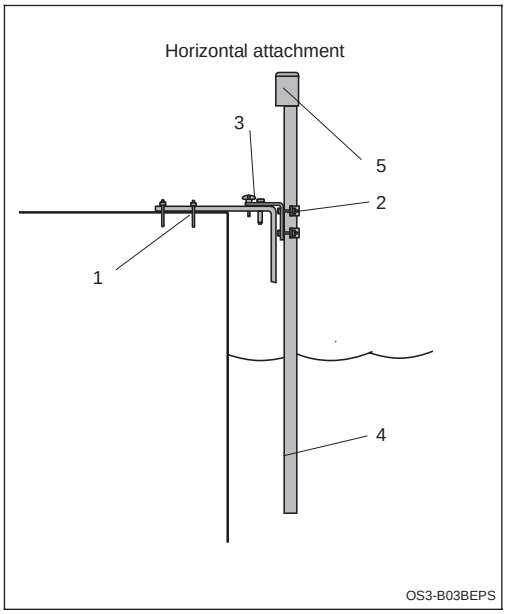
Basin wall mount

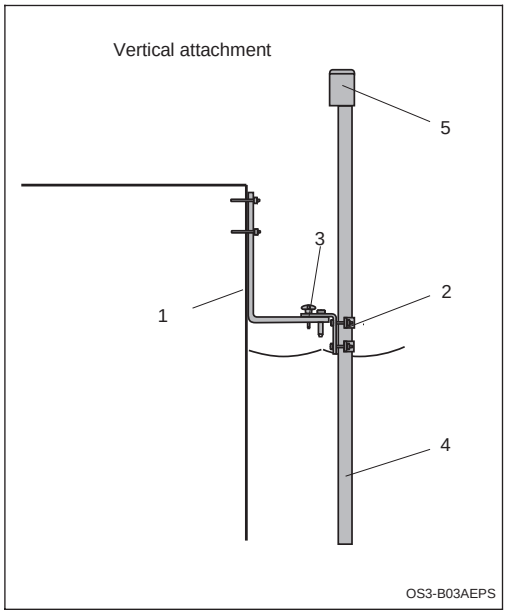
Construction: Basin wall mount CYY 106-A with immersion tube CYY 105-A (immersion tube length 2 m, see fig. 4.4) or CYY 105-B (immersion tube length 3.5 m, see fig. 4.3).

Simple installation on basin or channel walls with fixed distance from wall; no possibility for attachment of transmitter.

Caution:

In the case of strong turbulences or high flow rates, two basin wall mounts should be used for safe mounting of the immersion tube.

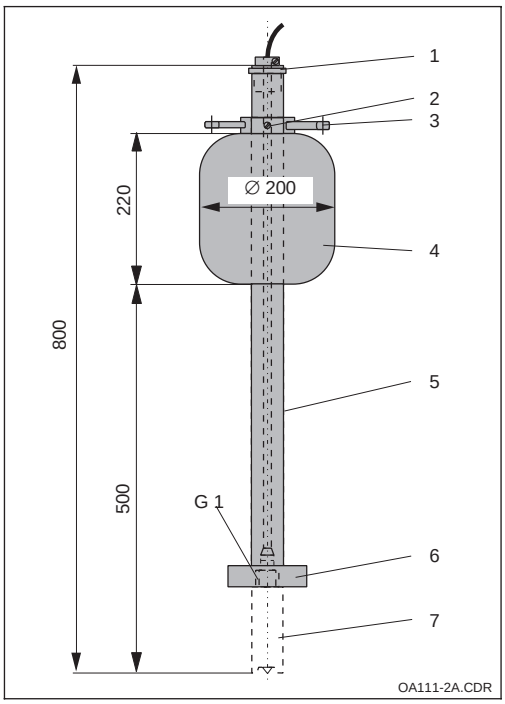




Basin wall attachment CYY 106-A with immersion tube CYY 105-A or -B

1 Basin wall mount
2 Tube holder
3 Star handle
4 Immersion tube of stainless steel 1.4301 (AISI 304)
5 Cover for cable entry

Fig. 4.4



Float body COA 110-50

1 Cable clamp with strain relief and rain protection
2 Fixing ring with clamping screw
3 Eyes, Ø 15; 3 × 120° for anchorage
4 Saltwater-resistant plastic float
5 Pipe 40 × 1 of stainless steel 1.4571 (AISI 316Ti)
6 Shock absorber and weight for stability
7 Oxygen sensor COS 4 / COS 4HD

Fig. 4.5

Float body

Construction: Float body COA 110-50. This assembly is used with widely fluctuating water levels, e.g. in rivers or lakes (see fig. 4.4).

4.3 Flow installation

Assembly for pipe or hose connection

Construction: Flow assembly COA 250-A. Assembly with bottom inlet and top outlet (connection via G ¾ thread) for automatic self-venting. Installation on one plane is possible when using two commercially available 90° elbows.

Accessories

- Spray head CUR 3
- Pipe clamp COY 250

Caution:

If pressure > air pressure:
There is no problem for the sensor with raising or holding at pressure. If there is a quick pressure drop at the measuring point it is possible that happens due to a reduced dissolubility a gas evolution of air in the electrolyte or blowing up of the membrane. These effect will be suppressed if the pressure is kept up at the sensor (manual: hand valves; automatic: solenoid valves).

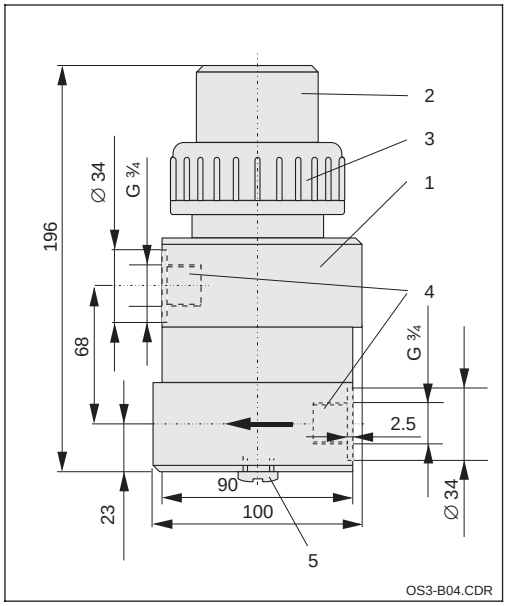


Fig. 4.6 Flow assembly COA 250-A

1 Base body
2 Sensor adapter
3 Coupling nut
4 G ¾ thread
5 Plug on installation thread for spray head CUR 3

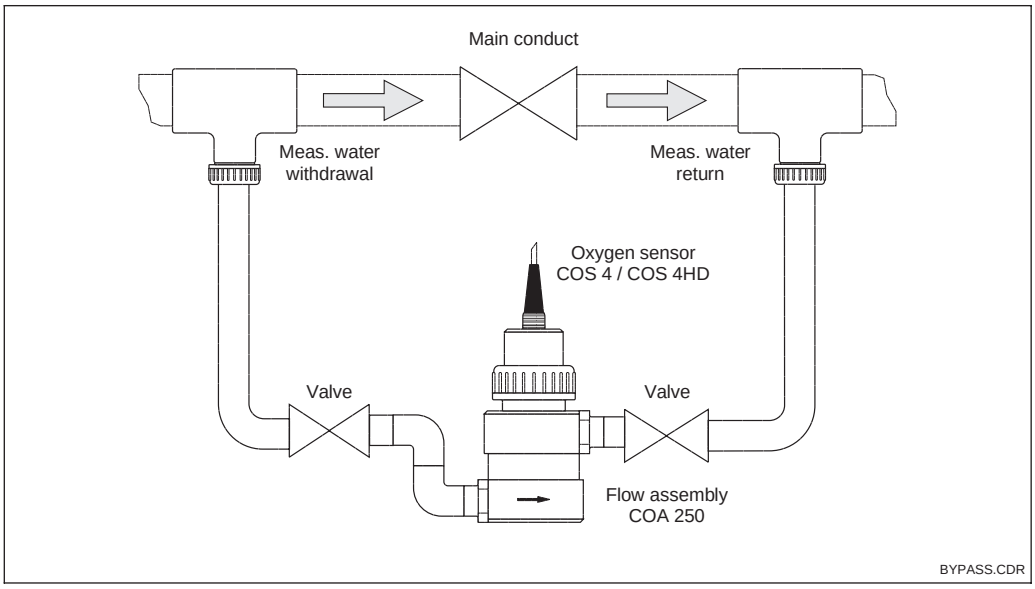


Fig. 4.7 Bypass installation with hand or solenoid valve if process pressure > atmospheric pressure

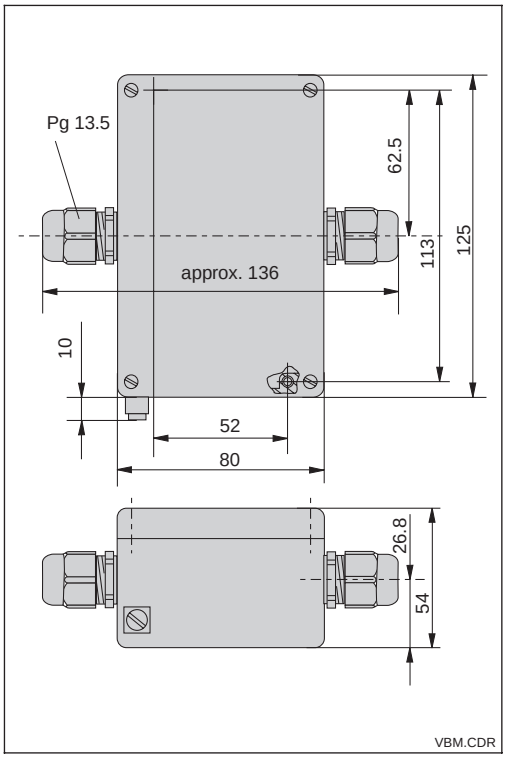
5 Electrical connection

5.1 Direct connection

The sensor is connected via the special multi-core measuring cable. Please refer to the wiring diagram in the installation and operating instructions of the corresponding transmitter:

- Liquisys COM 221 / 252
- Liquisys S COM 223 / 253.

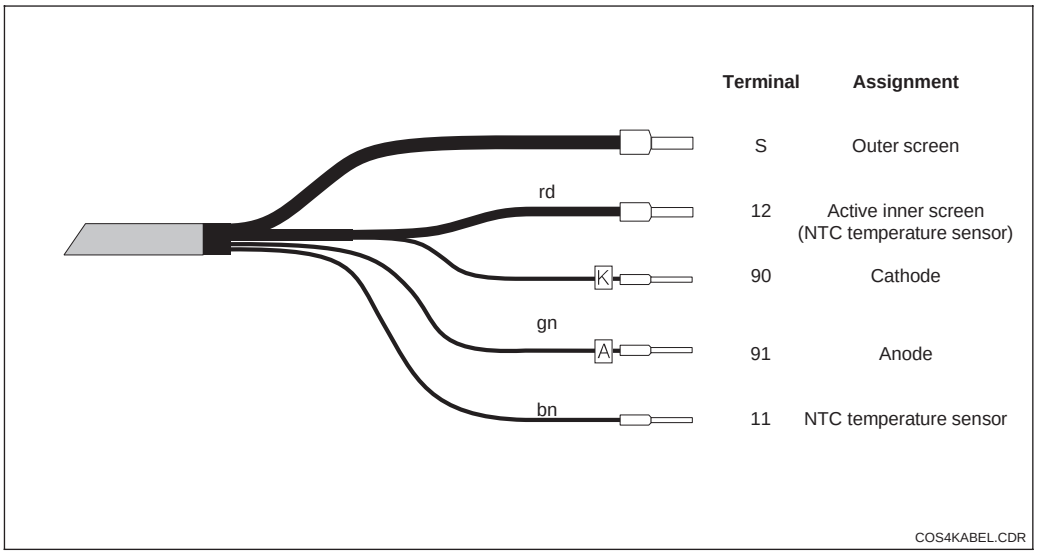
5.2 Connection via junction box VBM



Junction box VBM for extension of connecting cable between oxygen sensor COS 4 / COS 4HD and transmitter

Fig. 5.1

Junction box VBM (see fig. 5.1) is required to extend the connecting cable from the COS 4 / COS 4HD oxygen sensor to the transmitter beyond the length of the permanently attached cable using special measuring cable CMK (see fig. 5.3).



Terminated special measuring cable on COS 4 / COS 4HD

Fig. 5.2

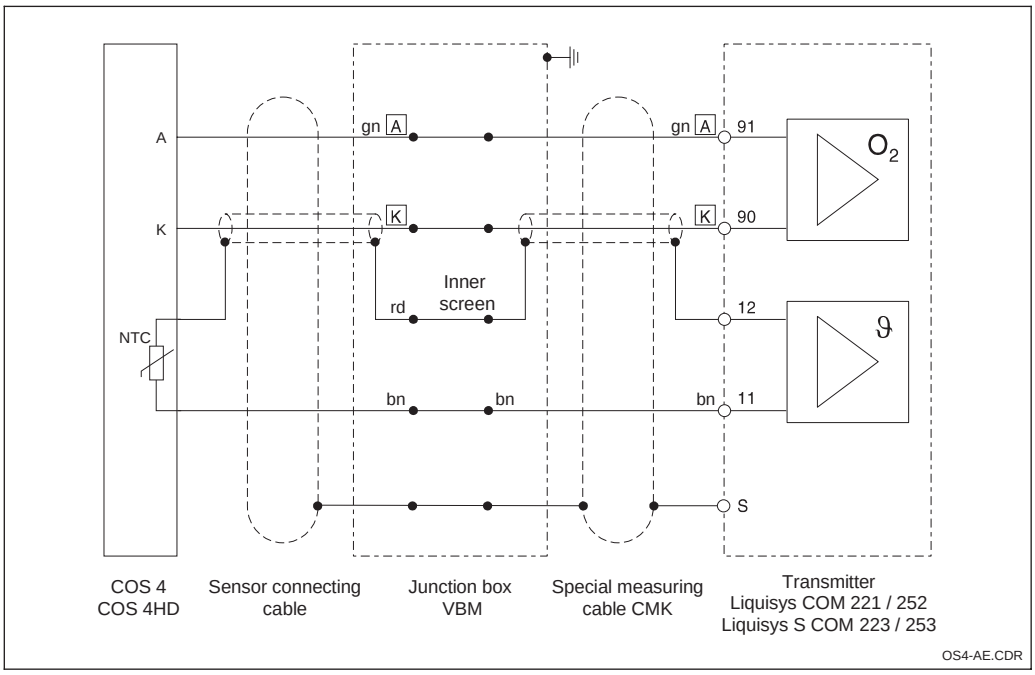


Fig. 5.3 Connection diagram with junction box VBM

6 Start-up

6.1 Polarisation

The sensor has been tested for proper operation at the factory and is shipped ready for operation. Proceed as follows to prepare the sensor for calibration:

- Pull off the sensor protection cap.
- The sensor should be dry on the outside. Most accurate calibration results are obtained if the air surrounding the sensor is saturated with water vapour. Therefore the sensor should be mounted close to a water surface but far enough above it to assure that the membrane stays dry during the entire calibration process.
- Apply the operating voltage.
- Wait for 60 min for the sensor to polarise (see chpt. 3.2). The end of polarisation can be identified by a stable, practically constant measured value display following initially elevated values that decrease over time. It follows the calibration.

Note:

Observe the start-up notes in the measuring transmitter operating instructions.

Caution:

Do not expose sensor to direct sunlight!

6.2 Calibration

During calibration, the transmitter is adapted to the characteristic values of the sensor. Since the COS 4 / COS 4HD sensor does not require zero calibration, the calibration can be performed as a one-point calibration in the presence of oxygen.

Two different calibration methods can be used:

- In air (saturated with water vapour if at all possible, e.g. above a water surface)
- In air-saturated water.

Since the preparation of air-saturated water is cumbersome, the simple air calibration is recommended for routine measurement.

The following prerequisites for calibration must exist:

- The sensor is completely polarised.
- The sensor is clean and dry on the outside.
- The sensor is located in air as close to a water surface as possible.

The sensor should be calibrated in the following cases:

- At start-up
- After membrane or electrolyte replacement
- After cleaning of the gold cathode
- Following extended interruptions in operation (sensor disconnected from power source)
- At regular intervals depending on experience.

Typical recalibration cycles for different applications are:

- Drinking water: 1 ... 6 months
- Water monitoring (rivers, lakes): 1 ... 4 months
- Municipal waste water: 1 ... 3 months
- Industrial waste water: 1 ... 2 months.

6.3 Air calibration sequence

Calibration	
1. Remove te sensor from the medium.	4. Wait approx. 20 min for the sensor to adapt to the ambient air temperature. Avoid direct exposure to sunlight.
2. Clean the sensor on the outside with a moist cloth or sponge and dry (particularly the membrane).	5. When the measured value display on the transmitter is stable, perform calibration according to transmitter Operating Instructions.
3. If the sensor has been removed for calibration from a closed pressure system with an operating pressure higher than the atmospheric pressure: Briefly open membrane cap for pressure compensation and clean if required. Replace filling electrolyte, then close up. Wait until the sensor is polarised.	6. Return the sensor to the medium after successful completion of calibration.

6.4 Example for computation of oxygen calibration value

For purposes of verification, the transmitter display value to be expected for the calibration can be computed as shown in the following example (salinity = 0):

a) Determine the following:
- Sensor temperature in air
- Altitude above sea level
- Atmospheric pressure at time of calibration **(comparative atmospheric pressure related to sea level)** in mbar. If not available, assume an air pressure of 1013 mbar for rough calculation

b) Use these value to determine:
- Saturation value **S** according to table 1
- Factor **K** according to table 2
- $\mathbf{L} = \frac{\text{atm. pressure during calibration}}{1013 \text{ mbar}}$
- **M** = 1.02 for air calibration
  1.00 for calibration in air-saturated water

c) Compute calibration value

Calibration value = S • K • L • M

Example: Air calibration with:
Temperature: 18 °C
Altitude ab. sea level: 500 m
Atmospheric pressure: 1022 mbar

Thus: S = 9.45 mg/l
K = 0.943
L = 1.0089
M = 1.02

Calibration value = 9.17 mg/l

°C	mg O_2/l	°C	mg O_2/l	°C	mg O_2/l	°C	mg O_2/l
0	14.64	10.5	11.12	21	8.90	31.5	7.36
0.5	14.43	11	10.99	21.5	8.82	32	7.30
1	14.23	11.5	10.87	22	8.73	32.5	7.24
1.5	14.03	12	10.75	22.5	8.65	33	7.18
2	13.83	12.5	10.63	23	8.57	33.5	7.12
2.5	13.64	13	10.51	23.5	8.49	34	7.06
3	13.45	13.5	10.39	24	8.41	34.5	7.00
3.5	13.27	14	10.28	24.5	8.33	35	6.94
4	13.09	14.5	10.17	25	8.25	35.5	6.89
4.5	12.92	15	10.06	25.5	8.18	36	6.83
5	12.75	15.5	9.95	26	8.11	36.5	6.78
5.5	12.58	16	9.85	26.5	8.03	37	6.72
6	12.42	16.5	9.74	27	7.96	37.5	6.67
6.5	12.26	17	9.64	27.5	7.89	38	6.61
7	12.11	17.5	9.54	28	7.82	38.5	6.56
7.5	11.96	18	9.45	28.5	7.75	39	6.51
8	11.81	18.5	9.35	29	7.69	39.5	6.46
8.5	11.67	19	9.26	29.5	7.62	40	6.41
9	11.53	19.5	9.17	30	7.55	40.5	6.36
9.5	11.39	20	9.08	30.5	7.49		
10	11.25	20.5	8.99	31	7.42		

Table 1: Atmospheric oxygen saturation value S in mg O_2/l of water as a function of temperature for an atmospheric pressure of 1013 mbar

Alt. in m	K	Alt. in m	K	Alt. in m	K	Alt. in m	K
0	1.000	360	0.959	720	0.919	1160	0.873
20	0.998	380	0.957	740	0.917	1200	0.869
40	0.995	400	0.954	760	0.915	1240	0.865
60	0.993	420	0.952	780	0.913	1280	0.861
80	0.991	440	0.950	800	0.911	1320	0.857
100	0.988	460	0.948	820	0.909	1360	0.853
120	0.986	480	0.946	840	0.907	1400	0.849
140	0.984	500	0.943	860	0.904	1440	0.845
160	0.981	520	0.941	880	0.902	1480	0.841
180	0.979	540	0.939	900	0.900	1520	0.837
200	0.977	560	0.937	920	0.898	1560	0.833
220	0.975	580	0.935	940	0.896	1600	0.830
240	0.972	600	0.932	960	0.894	1700	0.820
260	0.970	620	0.930	980	0.892	1800	0.810
280	0.968	640	0.928	1000	0.890	1900	0.801
300	0.966	660	0.926	1040	0.886	2000	0.792
320	0.963	680	0.924	1080	0.882		
340	0.961	700	0.922	1120	0.877		

Table 2: Correction factor K as a function of mean altitude (above sea level)

7 Maintenance

The following maintenance work is to be performed at regular intervals. To assure regular maintenance, we recommend entering the maintenance dates in an operator's log or calendar beforehand.

1. Check the measuring function at regular intervals. The length of these intervals depends on the medium (soiling, waste load). **The measuring function can be checked very simply by removing the sensor from the medium and exposing it to air.** Following membrane cleaning and drying, a measured value as close as possible to the calibration value for the existing conditions (acc. to chpt. 6.4) in mg/l (waiting time 45 min) or to a saturation index of 102% (waiting time 10 min) should be displayed within a short period.
2. External cleaning, especially if the membrane is soiled. Dirt deposits and grease on the membrane may cause inaccurate measured values.
3. Recalibration (s. chpt. 6.2 and 6.3).
4. Replacement of a membrane that is defective, extremely soiled or can no longer be cleaned.

Caution:

Do not touch the membrane with sharp-edged or pointed objects. Do not injure the membrane!

The sensor can be retrofitted with the Chemoclean cleaning system for regular automatic cleaning (see accessories).

7.1 External cleaning

Clean the sensor with the following agents according to the type of soiling:

Type of soiling	Cleaning measures
Salt deposits	Immerse sensor in drinking water or 1 ... 5% hydrochloric acid (for a few minutes only) and rinse
Dirt particles, dirt adhering to sensor body (**not membrane!**)	Clean sensor with water using a brush
Dirt particles, dirt adhering to membrane cap or membrane	Clean sensor with water using a sponge

8 Regeneration

Different parts of the sensor are subject to natural wear during operation. Normal operation may be restored by the use of accessories or by replacing worn parts. The following simple remedial measures are described in the sections below:

Measure	Cause
Electrode cleaning (gold cathode) Chpt. 8.1	Gold cathode soiled or with silver coating
Sealing ring replacement Chpt. 8.2	Seal visibly damaged
Electrolyte replacement Chpt. 8.3	Rapidly changed, implausible signal (e.g., too high) or electrolyte contaminated
Membrane cap replacement Chpt. 8.4	If membrane: • is heavily soiled • can no longer be cleaned • is overstretched (no longer fits tightly) • is damaged (hole)

Warning:

Turn the power to the measuring transmitter off before the beginning of regeneration.

8.1 Electrode cleaning

Cleaning of the **gold electrode** is only necessary when this electrode is visibly soiled or has a silver coating.

- Clean gold surface carefully with fine abrasive paper (approx. 2400 grain) until the (silver) coating is completely removed.
- Rinse electrodes with pure water.
- Fill fresh electrolyte COY 3-F (for sensor COS 4) or COY 3HD-F (for sensor COS 4HD) into membrane cap and close up cap.

Caution:

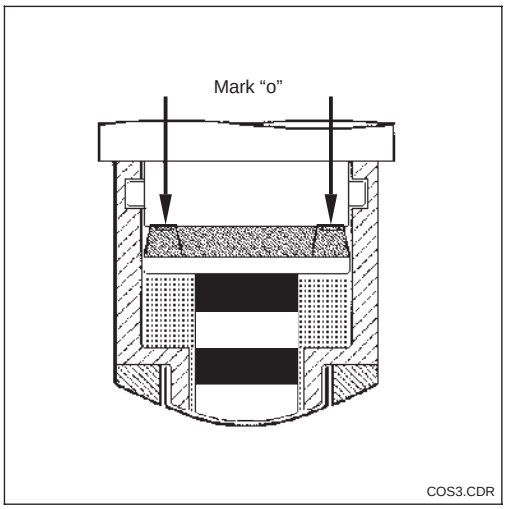
A brownish silver bromide (COS 4) or silver chloride coat (COS 4HD) is applied to the **anode** at the factory; therefore this electrode **must never be cleaned.** When this coating comes off in the course of operation, the sensor can no longer be used for measurement and must be returned to the manufacturer for recoating.

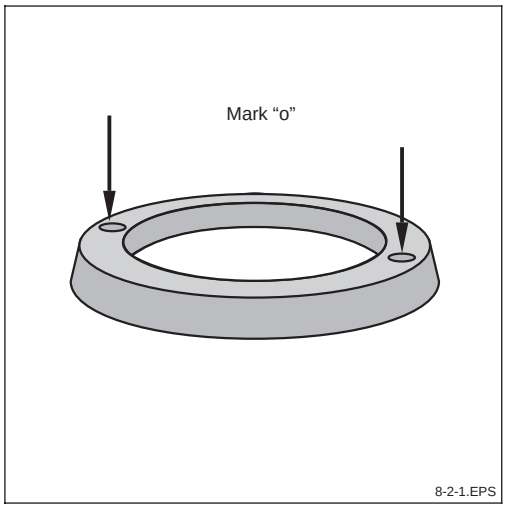
8.2 Trapezoid seal replacement

Trapezoid seal replacement becomes necessary when the sealing ring is visibly damaged. You have to use the trapezoid seals COY 3-TR (see accessories).

Caution:

The sealing ring may only be installed as shown in fig. 8.1.





left:
Install sealing ring with marks pointing upward

right:
Marks on top of trapezoid sealing ring

Fig. 8.1

8.3 Electrolyte replacement

The electrolyte is slowly used up during measuring operation due to electrochemical processes at the electrodes. No electrolyte is consumed when the sensor is disconnected from power.

The theoretical operating time of an electrolyte filling for air-saturated drinking-quality water and 20 °C is:
- Sensor COS 4 with electrolyte COY 3-F: max. 5 years
- Sensor COS 4HD with electrolyte COY 3HD-F: max. 5 years.

Please note that penetration of foreign substances, e.g. H_2S, NH_3 or large quantities of CO_2, may shorten the operating time of the electrolyte.

Therefore, particular attention should be paid to:
- Anaerobic stages (e.g., denitrification)
- Strongly polluted industrial waste water, especially in conjunction with elevated medium temperatures.

Warning:

The COY 3-F and COY 3HD-F electrolytes are strong alkalis. Observation of applicable protective regulations is therefore mandatory (for example, wear protective clothing, protective goggles, protective gloves).

8.4 Membrane cap replacement

Removal of old membrane cap

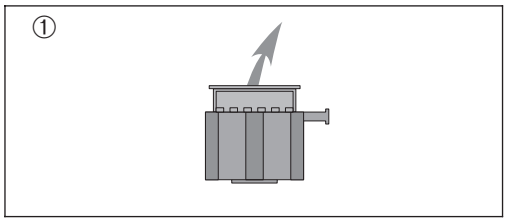
- Remove sensor from medium
- Unscrew protection guard
- Clean sensor carefully on the outside
- Remove membrane cap (bayonet lock)
- Clean the gold cathode if required or replace the sealing ring (only if damaged)
- Rinse the electrode holder with pure water

Installation of new membrane cap

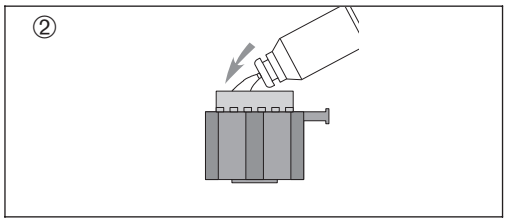
Caution:

Use only membrane cap COY 3-WP (yellow lid) for sensor COS 4 / COS 4HD.

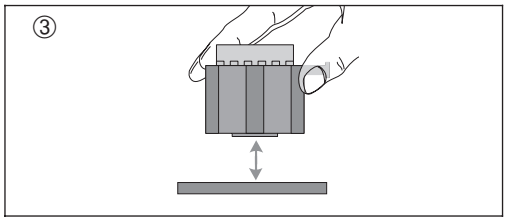
- Inspect visually for dirt particles adhering to the sealing surfaces.
- Install the membrane cap according to fig. 2 ... 6 using fresh electrolyte.
- Screw the protection guard back on.
- Allow the sensor to polarise, then perform air calibration.
- Return sensor to medium. Verify that the transmitter does not indicate an alarm condition.
  If an alarm is indicated s. chpt. 9, error handling.



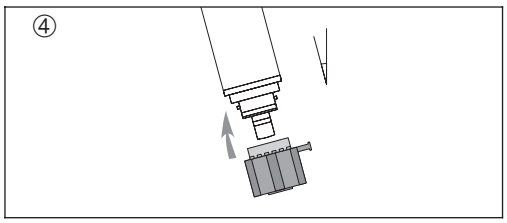
Remove lid.



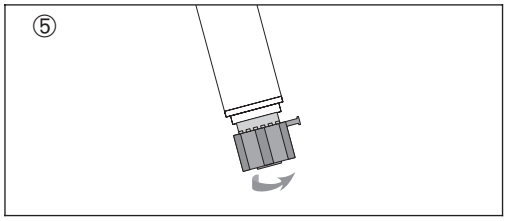
Pour entire contents of a plastic ampoule with liquid electrolyte COY 3-F (for COS 4) or COY 3HD-F (for COS 4HD) into membrane cap.



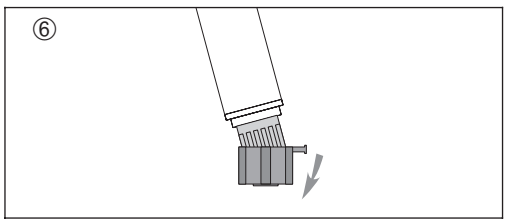
Tap membrane cap against a flat surface until electrolyte is completely free from air bubbles.



Insert membrane cap **very slowly** all the way into sensor body **held at an angle.**



Turn membrane cap until latched in.



Remove mounting cap from sensor using pull tab.

9 Error handling

9.1 Measuring system check

The measures described below, taken in the indicated sequence, can be used to pinpoint and possibly eliminate the source of the problems listed.

Check	Problem elimination
No display, no sensor response	
1. Is transmitter supplied with power? 2. Is sensor connected to transmitter correctly? 3. Is medium flow adequate? 4. Is membrane completely coated? 5. Does measuring chamber contain electrolyte?	• Switch power on. • Connect sensor or check the electrical connection. • Establish medium flow. • Clean sensor (s. chpt. 7.1). • Fill electrolyte into measuring chamber.
Display value too high	
1. Is polarisation time over? 2. Has the instrument been calibrated before (with a different sensor)? 3. Is the temperature display on the transmitter conspicuously low? 4. Remove sensor from medium and dry. Correct membrane cap installed on sensor? (COY 3-WP has no mark. COY 3S-WP with the mark “S” in near the membrane must not be used). 5. Does membrane have a visible bulge? 6. Open measuring chamber. Is the electrolyte soiled? 7. Dry electrodes. Does the transmitter display go back to zero? 8. Is the brown anode coating gone, silver coating on electrode? 9. Silver coating on gold cathode?	• Wait until sensor is completely polarised. • Perform calibration. • Return sensor to manufacturer. • COY 3-WP cap for COS 4 / COS 4HD. (Do not use COY 3S-WP!). • Install new membrane cap (s. chpt. 8.4). • Clean measuring chamber and fill in fresh electrolyte (s. chpt. 8.3). • Check connecting line (and junction box where used) for shunt. If all the same not OK, return sensor to manufacturer. • Return sensor to manufacturer for recoating. • Clean gold cathode (s. chpt. 8.1).
Display value too low	
1. Has sensor been calibrated? 2. Is medium flow adequate? 3. Is the temperature display on the transmitter conspicuously high? 4. Visible coating on membrane? 5. Open measuring chamber. Is the electrolyte soiled?	• Perform calibration. • Establish required medium flow. • Return sensor to manufacturer. • Clean membrane or replace membrane cap (s. chpt. 7.1 and 8.4). • Clean measuring chamber and fill in fresh electrolyte (s. chpt. 8.3).
Display value fluctuates considerably	
1. Does membrane have a visible bulge? 2. Open measuring chamber and dry electrodes. Does the transmitter display go back to zero? 3. Existing of EMC dispersion to the transmitter?	• Install new membrane cap. • Check connecting line (and junction box where used) for shunt. If not OK, return sensor to manufacturer. • Ground the transmitter (concerning PE terminal of COM 221 / 253). • Connect outer screen of the sensor and extension cord (if available) to terminal S. • Install measuring signal wire separately to high voltage wires.

9.2 Transmitter check

Caution:

Requirements for measuring transmitter check:
- Basic electrical knowledge
- Multimeter.

The following resistors are also required:
37.4 kΩ *)
2.61 MΩ *)

Measure	Desired value
Voltage check	
Disconnect oxygen sensor COS 4 / 4HD and measure polarisation voltage in conjunction with: – Liquisys COM 221 / 252 – Liquisys S COM 223 / 253	 –750 mV: between terminals 90 and 91 –650 mV: between terminals 90 and 91 (–750 mV for instruments before May 2000)
Zero check	
Switch unit off (power OFF) and connect the following resistor in conjunction with: – Liquisys COM 221 / 252 and Liquisys S COM 223 / 253: 37.4 kΩ between terminals 11 and 12 Terminals 90 and 91 open Switch unit on (power ON):	 Value on display: **0.00 mg/l** (or **0.0% SAT**) and **20 °C** Current output: **0** or **4** mA
Slope check	
Switch unit off (power OFF) and connect the following resistor: – Liquisys COM 221 / 252 and Liquisys S COM 223 / 253: 37.4 kΩ between terminals 11 and 12 2.61 MΩ between terminals 90 and 91 Switch unit on (power ON):	 For altitude entry of 0 m and 0% salinity input: Display: 6.00 ... 11.20 mg/l and 20 °C (or 85 ... 157% SAT) depending on last calibration Display: 9.20 ... 9.30 mg/l and 20 °C (or 102% SAT) after recalibration **Caution:** You must carry out a new calibration of the transmitter with the sensor!

*) For the function test you can use also deviate resistance values (e.g. the next standard value). See chpt. 9.3 table “temperature sensor check”.

9.3 Sensor check

Measure	Desired value
Voltage check	
Measure polarisation voltage with oxygen sensor COS 4 / COS 4HD connected in conjunction with: – Liquisys COM 221 / 252 (COS 4 only) – Liquisys S COM 223 / 253	 –750 mV between terminals 90 and 91 –650 mV between terminals 90 and 91 (–750 mV for instruments before May 2000)
Slope check	
Remove sensor from medium and dry with paper towel (especially the membrane).	Display after waiting time of 10 min should be as close to 102% SAT as possible
Zero check	
Immerse sensor in zero solution (s. accessories) and move in solution. Wait during the adaption time of about 15 min. Open measuring chamber and dry electrodes.	Display should be as close as possible to 0 mg/l (or 0% SAT) Display should be as close as possible to 0 mg/l (or 0% SAT)
Temperature sensor check	
Measure between red and brown wire with sensor disconnected.	Depending on temperature: 5 °C: 74.4 kΩ 10 °C: 58.7 kΩ 15 °C: 46.7 kΩ 20 °C: 37.3 kΩ 25 °C: 30.0 kΩ 30 °C: 24.3 kΩ

10 Technical data

General specifications

Manufacturer	Endress+Hauser
Product designation	COS 4 / COS 4HD

Mechanical data

Measuring principle	membrane-covered amperometric sensor
Materials	sensor body: PBT; membrane cap: PEEK
Operating time of one filling with COY 3-F (COS 4) or COY 3HD-F (COS 4HD)	max. 5 years (theoretical electrolytic reserve with air saturation at 20 °C)
Membrane thickness	approx. 50 µm
Threaded connections	G 1 and NPT ¾"
Electrical connection	double-screened coaxial cable with 2 auxiliary cores, clamped connection
Cable lenghts	7 m, 15 m
Max. total cable length with cable extension	50 m
Weight without packing (with cable length)	0.7 kg (7 m) or 1.1 kg (15 m)

Measuring range

Lower measuring range limit	0.070 mg/l at 5 °C 0.035 mg/l at 20 °C 0.015 mg/l at 40 °C
Upper measuring range limit	20 mg/l
Temperature compensation	with NTC temperature sensor, 0 ... 50 °C

Operating data

Response time	90% of upper range-value after 3 min at 20 °C 99% of upper range-value after 9 min at 20 °C
Polarisation time	< 60 min
Minimum flow velocity	typically 0.5 cm/s for 95% measured value display
Sensor monitoring	in connection with the transmitter: cable interruption or short-circuit, measured error and sensor passivation
Drift	under continuous polarisation: < 1%/month
Zero current	none

Temperature and pressure

Max. permissible overpressure (membrane side)	3 bar
Max. permissible overpressure (cable side)	1 bar
Ingress protection	IP 68
Nominal operating temperature	–5 ... 50 °C
Storage temperature	filled: –5 ... 50 °C, unfilled: –20 ... 60 °C
Temperature compensation	with NTC temperature sensor, 0 ... 50 °C

Subject to modifications.

11 Accessories

The following accessories can be ordered separately:

- Replacement cartridge COY 3-WP
  (with yellow cap)
  2 replacement cartridges, ready for use, with pre-tensioned membrane
  for COS 4 and COS 4HD
  Order No.: 50053348

- Filling electrolyte COY 3-F
  for COS 4
  10 plastic ampoules, transparent
  Order No.: 50053349

- Filling electrolyte COY 3HD-F
  for COS 4HD
  10 plastic ampoules, red
  Order No.: 51503267

- Trapezoid seal COY 3-TR
  for COS 4 and COS 4HD
  3 pcs., lubricated,
  Order No.: 50080252

- Membrane protection guard COY 3-SK
  for COS 4
  for use in fish ponds
  Order No.: 50081787

- Baffle plate OP
  Baffle plate for additional mechanical protection under extreme flow conditions (optional accessory for assembly COA 110)
  Order No.: 50028712

- Zero solution
  Three bottles for production of 3 × 1 litre oxygen-free solution
  Order No.: 50001041

Electrical equipment, cables and cleaning equipment

- Junction box VBM
  for extensions with measuring cable CMK.
  2 Pg 13.5 cable glands for cable entry and 10 insulated high-resistance screw terminals for single-wire connection
  Dimensions: 125 × 80 × 54 mm (L × W × H)
  Material: aluminium painted
  Ingress protection: IP 65
  Order No.: 50003987

- Measuring cable CMK
  Special cable for extension of connecting line between sensor and transmitter
  Order No.: 50005374

- Chemoclean
  Injector unit CYR 10
  Programme sequencer CYR 20

- Spray head COR 3 for immersion operation

- Spray head CUR 3 for connection at the bottom of assembly COA 250

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