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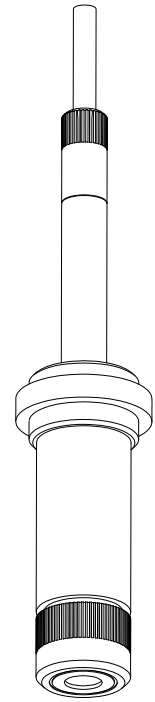
Operating Instructions
CCS140/141

Sensors for measuring free available chlorine



Endress+Hauser
People for Process Automation

Table of contents

1 About this document

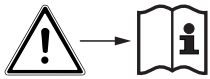
1.1 Warnings

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

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

1.2.1 Symbols on the device

Symbol	Meaning
	Reference to device documentation

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.
- Measuring point faults may be repaired only 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 Designated use

Drinking water, process water and bathing water must be disinfected through the addition of appropriate disinfectants such as chlorine gas or inorganic chlorine compounds. The dosing quantity must be adapted to continuously fluctuating operating conditions. Too low concentrations in the water could jeopardize the effectiveness of the disinfection. Too high concentrations can lead to signs of corrosion and have an adverse effect on the taste and smell, while also generating unnecessary costs.

The sensor was specifically developed for this application and is designed for continuous measurement of free chlorine in water. In conjunction with measuring and control equipment, it allows optimal control of disinfection.

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

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

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.

2.4.1 Special instructions

▶ Do not operate the sensors under process conditions where it is expected that osmotic conditions will cause electrolyte components to pass through the membrane and into the process.

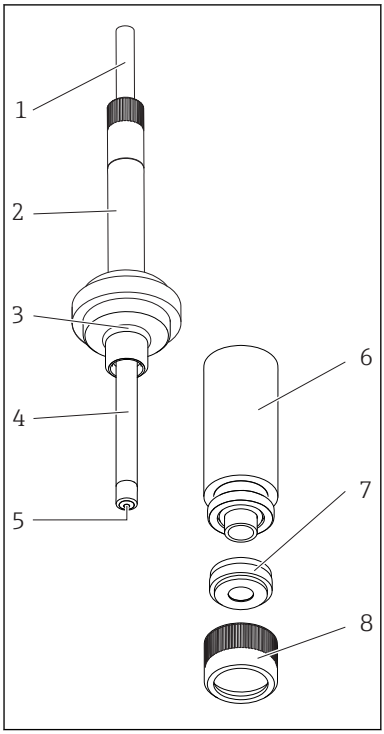
2.5 Product safety

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 Product description

3.1 Product design

The sensor consists of the following functional units:
- Measuring chamber
  - To protect the anode or cathode from the medium
  - With a large volume of electrolyte for a long service life in combination with the large anode and the small cathode
- Sensor shaft with
  - Large anode
  - Cathode embedded in plastic
  - Optional temperature sensor
- Membrane cap with
  - Robust PTFE membrane
  - Special support grid between cathode and membrane for a defined and consistent electrolyte film and thus a relatively constant indication even at varying pressures and flows



1 *Fixed cable*
2 *Sensor shaft*
3 *O-ring*
4 *Large anode, silver/silver chloride*
5 *Gold cathode*
6 *Measuring chamber*
7 *Membrane cap with dirt-repellent membrane*
8 *Screw cap for securing the membrane cap*

3.1.1 Measuring principle

Free available chlorine levels are determined using hypochlorous acid (HOCl) in accordance with the amperometric measuring principle.

The hypochlorous acid (HOCl) contained in the medium diffuses through the sensor membrane and is reduced to chloride ions (Cl^-) at the gold cathode. At the silver anode, silver is oxidized to silver chloride. Electron donation at the gold cathode and electron acceptance at the silver anode causes a current to flow which is proportional to the concentration of free chlorine in the medium at constant conditions.

The concentration of hypochlorous acid (HOCl) depends on the pH value. An additional pH measurement should be used to compensate for this dependency.

The transmitter uses the current signal to calculate the measured variable for concentration in mg/l (ppm).

3.1.2 Effects on the measured signal

pH value

pH dependency

Molecular chlorine (Cl_2) is present at pH values < 4. Consequently, hypochlorous acid (HOCl) and hypochlorite (OCl^- remain within the range of pH 4 to 11 as components of free chlorine.

As hypochlorous acid splits up (dissociates) with an increasing pH value to form hypochlorite ions (OCl^-) and hydrogen ions (H^+), the amounts of the individual components of free effective chlorine change with the pH value. For example, if the proportion of hypochlorous acid is 97 % at pH 6, it drops to approx. 3 % at pH 9.

For amperometric measurement using the chlorine sensor, only the amount of hypochlorous acid (HOCl) is selectively measured. This works as a powerful disinfectant in an aqueous solution. Hypochlorite (OCl^-), however, is an extremely weak disinfectant. Therefore, when used as a disinfectant at higher pH values, the effectiveness of chlorine is limited. Since hypochlorite ions cannot pass through the sensor membrane, the sensor does not record this part.

pH compensation of chlorine sensor signal

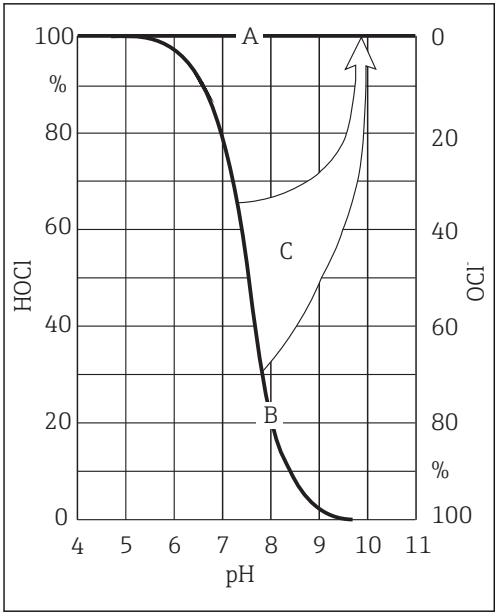
To calibrate and verify the chlorine measuring system, a colorimetric reference measurement must be carried out using the DPD method. Free chlorine reacts with diethyl-p-phenylendiamine to form a red dye. The intensity of the red color increases proportionally to the chlorine content. For the DPD test, the sample is buffered to a specified pH value. Therefore, the pH value of the sample is not taken into account in the DPD measurement. Due to the buffer function in the DPD method, all components of free effective chlorine (HOCl and OCl^-) are detected and thus the total free chlorine is measured.

The chlorine sensor only measures the hypochlorous acid. If you select pH compensation in the transmitter, the sum of hypochlorous acid and hypochlorite is calculated from the measured signal and the pH value. This value corresponds to the DPD measurement.

When free chlorine is measured with pH compensation switched on, always perform calibration in pH-compensated mode.

When you use pH compensation, the measured chlorine value displayed and output by the device corresponds to the DPD value even if the pH value fluctuates. If no pH compensation is used, the chlorine value of the DPD measurement corresponds only to the chlorine value of

the sensor at the same pH value with respect to the calibration. Without pH compensation, the chlorine measuring system must be recalibrated when the pH value changes.



1 Principle of pH compensation

A Measured value with pH compensation
B Measured value without pH compensation
C pH compensation

Accuracy of pH compensation

The accuracy of the pH-compensated measured chlorine value is derived from the sum of several individual deviations (free chlorine, pH, temperature, DPD measurement etc.).

High levels of hypochlorous acid (HOCl) during chlorine calibration have a positive effect on accuracy, whereas low levels of hypochlorous acid have a negative effect. The inaccuracy of the pH-compensated measured chlorine value increases the greater the pH difference between measuring mode and chlorine calibration or the more inaccurate the underlying individual measured values are.

Calibration taking into account the pH value

For the DPD test, the sample is buffered to a specified pH value. In contrast to this, amperometric measurement determines only the HOCl component.

During operation, pH compensation is effective up to a pH value of 9. However, there is virtually no hypochlorous acid (HOCl) left at this pH value, and the measured current is very low. At this point, pH compensation has the effect of increasing the measured HOCl value to

the actual value of the free chlorine. Calibration of the entire measuring system is practicable only if the medium has a pH value of 8 (CCS140) or pH value of 8.2 (CCS141).

Sensor	pH value	HOCl content	Uncompensated value	Compensated value
CCS141	8.2	15 %	12 nA	80 nA
CCS140	8.0	20 %	4 nA	20 nA

Above these pH values, the total error of the measuring system is unacceptably high.

Flow

The minimum flow velocity of the membrane-covered measuring cell is 15 cm/s (0.5 ft/s). When using the CCA250 flow assembly, this corresponds to a flow rate of 30 l/h (7.9 gal/h) (upper edge of float at level of red bar mark).

At higher flow rates, the measured signal is virtually flow-independent. However, if the flow rate falls below the specified value, the measured signal depends on the flow.

The installation of an INS proximity switch in the assembly enables reliable detection of this invalid operating status, thus triggering an alarm or causing the dosing process to be switched off if necessary.

Below the minimum flow rate, the sensor current is more sensitive to flow fluctuations. For abrasive media, it is recommended not to exceed the minimum flow. If suspended solids are present, which may form deposits, the maximum flow rate is recommended.

Temperature

Changes in the temperature of the medium affect the measured value:
- Increases in temperature result in a higher measured value (approx. 4 % per K)
- Decreases in temperature result in a lower measured value.

Using the sensor in combination with the Liquisys CCM223/253 enables automatic temperature compensation (ATC). Recalibration in the case of temperature changes is not necessary.

1. If automatic temperature compensation is disabled at the transmitter, the temperature must be maintained at a constant level following calibration.
2. Otherwise, recalibrate the sensor.

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 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 information on the nameplate with the order.

4.2.2 Product page

www.endress.com/ccs140

www.endress.com/ccs141

4.2.3 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 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.

4.2.4 Manufacturer address

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

4.2.5 Scope of delivery

The delivery comprises:
- Chlorine sensor with protection cap (ready for use)
- Bottle with electrolyte (50 ml (1.69 fl.oz))
- Replacement cartridge with pretensioned membrane
- Operating Instructions
- Manufacturer's certificate

4.2.6 Certificates and approvals

CE mark

Declaration of conformity

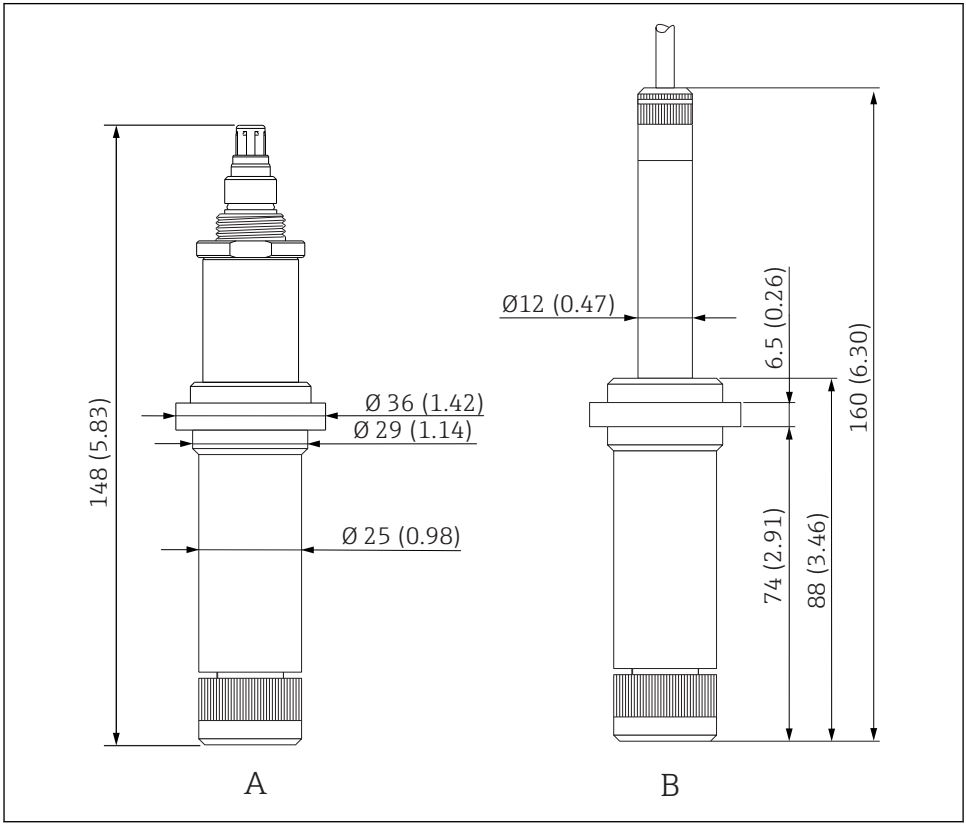
The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

5 Installation

5.1 Installation conditions

5.1.1 Installation position

5.1.2 Dimensions



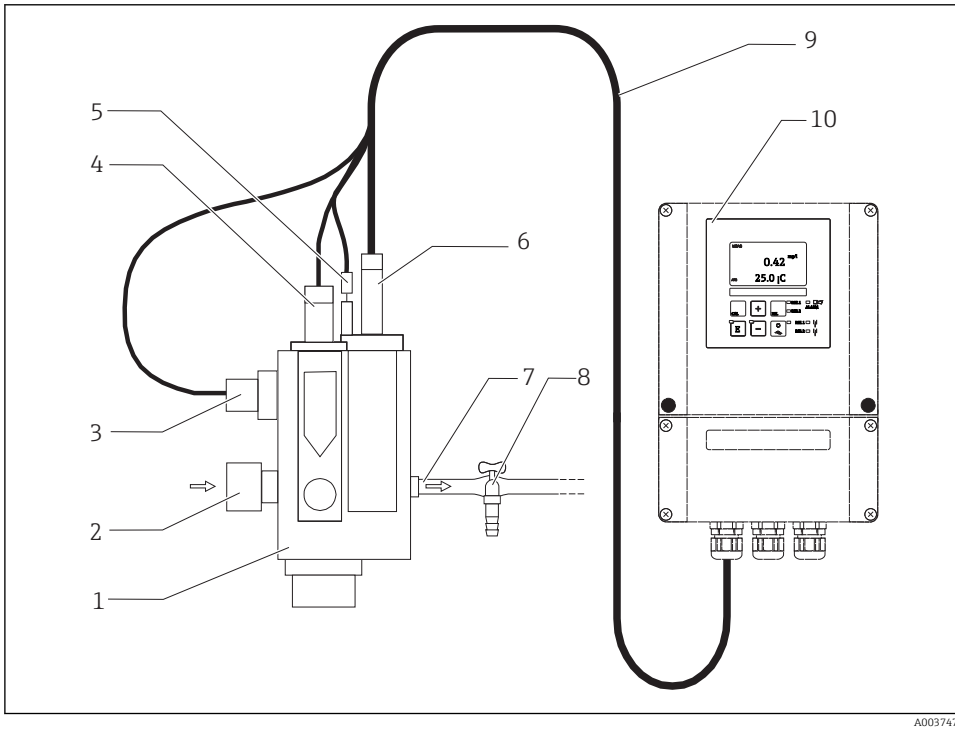
2 Dimensions in mm (in)

A Version with TOP68 plug-in head
B Version with fixed cable connection

5.2 Mounting the sensor

5.2.1 Measuring system

A complete measuring system comprises:
- Chlorine sensor
- Liquisys CCM223/253 transmitter
- Measuring cable CPK9
- Flowfit CCA250 flow assembly
- Optional: extension cable CYK71



3 Example of a measuring system

1 Flowfit CCA250 flow assembly
2 Inlet to Flowfit CCA250 flow assembly
3 Proximity switch (optional)
4 pH sensor CPS31
5 PML pin
6 Chlorine sensor CCS140
7 Procedure
8 Sampling tap
9 Measuring cable CPK9
10 Liquisys CCM223/253 transmitter

- Ground the medium at the sensor by means of the PML pin to ensure a high reading stability.

5.2.2 Preparing the sensor

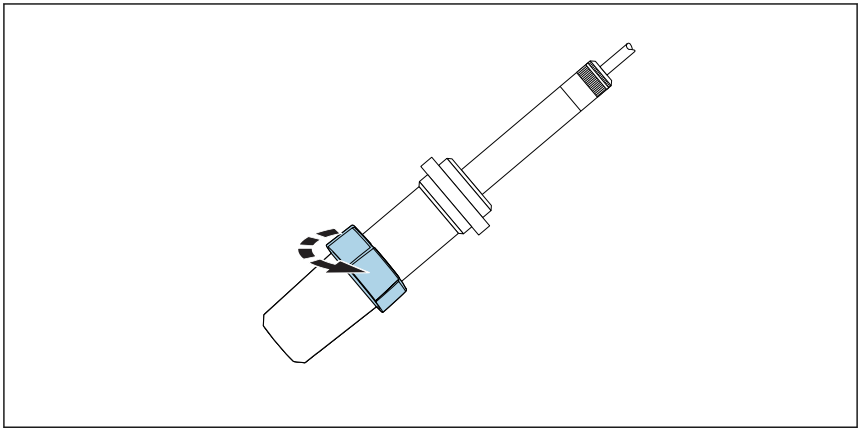
Removing protection cap from sensor

NOTICE

Negative pressure causes damage to the sensor's membrane cap.

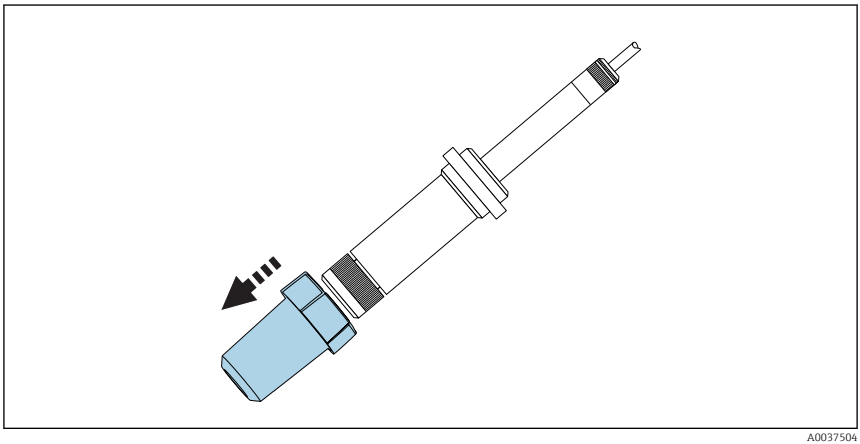
- If the protection cap is attached, carefully remove it from sensor.

1. When supplied to the customer and when in storage, the sensor is fitted with a protection cap: First release just the top part of the protection cap by turning it.



4 *Releasing top part of protection cap by turning*

2. Carefully remove protection cap from sensor.



5 *Carefully remove protection cap*

5.2.3 Installing sensor in assembly CCA250

The Flowfit CCA250 flow assembly is designed for installing the sensor. It allows a pH and ORP sensor to be installed, in addition to the chlorine or chlorine dioxide sensor. A needle valve controls the flow rate in the range of 30 to 120 l/h (7.9 to 31.7 gal/h).

Please note the following during installation:
- The flow rate must be at least 30 l/h (7.9 gal/h). If the flow drops below this value or stops completely, this can be detected by an inductive proximity switch and used to trigger an alarm with locking of the dosage pumps.
- If the medium is returned to an overflow basin, pipe or similar, the resulting counterpressure on the sensor must not exceed 1 bar (14.5 psi) and must remain constant.
- Negative pressure at the sensor e. g. caused by feedback of the medium to the suction side of a pump, must be avoided.
- To avoid buildup, heavily contaminated water should also be filtered.

Additional installation instructions can be found in the Operating Instructions for the assembly.

5.2.4 Installing sensor in other flow assemblies

When using other flow assemblies, please ensure the following:
- A flow velocity of at least 15 cm/s (0.49 ft/s) must be guaranteed at all times at the membrane.
- The flow direction is upwards. Transported air bubbles must be removed so that they do not collect in front of the membrane.
- The flow must be directed to the membrane.

5.3 Post-installation check

1. Check the membrane to ensure it is sealed and undamaged.
   ↳ Replace if necessary.
2. Is the sensor installed in an assembly and not suspended from the cable?
   ↳ The sensor may be installed only in an assembly or directly via the process connection.

6 Electrical connection

CAUTION

Device is live

Incorrect connection may result in injury!
- 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

▶ Install the grounding bar (order number 51501086) in accordance with the accompanying instructions in order to guarantee a high reading stability.

NOTICE

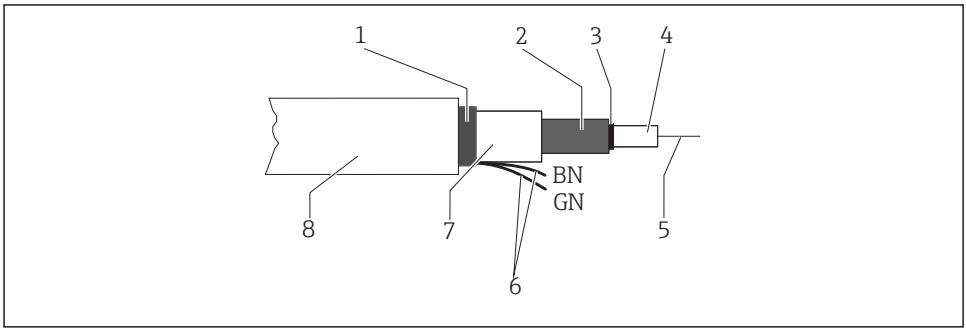
Measured errors due to faulty connection

▶ When connecting the sensor cable, make sure that the black semi-conductor layer is removed as far as the inner shield.

The sensors have a fixed cable with a maximum length of 3 m (9.8 ft).

▶ Connect the sensors to the transmitter according to the following diagram:

Sensor: assignment	Sensor: core	Transmitter: terminal
Outer shield		S
Anode	[A] red	91
Cathode	[K] transparent	90
NTC temperature sensor	Green	11
NTC temperature sensor	Brown	12



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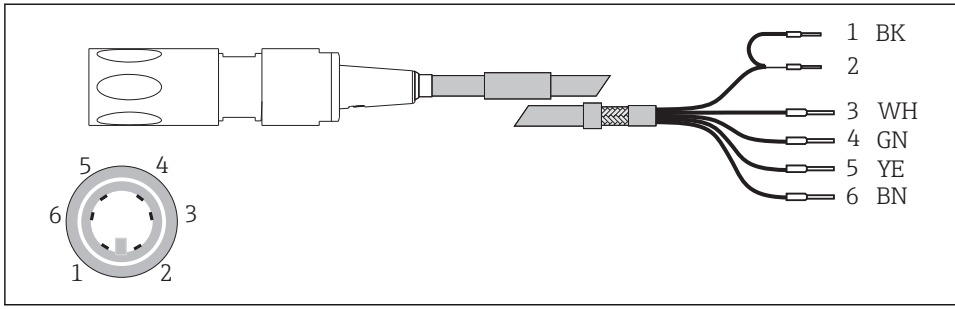
6 Structure of the sensor cable

1 Outer shield
2 Inner shield, anode
3 Semi-conductor layer
4 Inner insulation
5 Inner conductor, measured signal
6 Temperature sensor connection
7 2nd insulation
8 Outer insulation



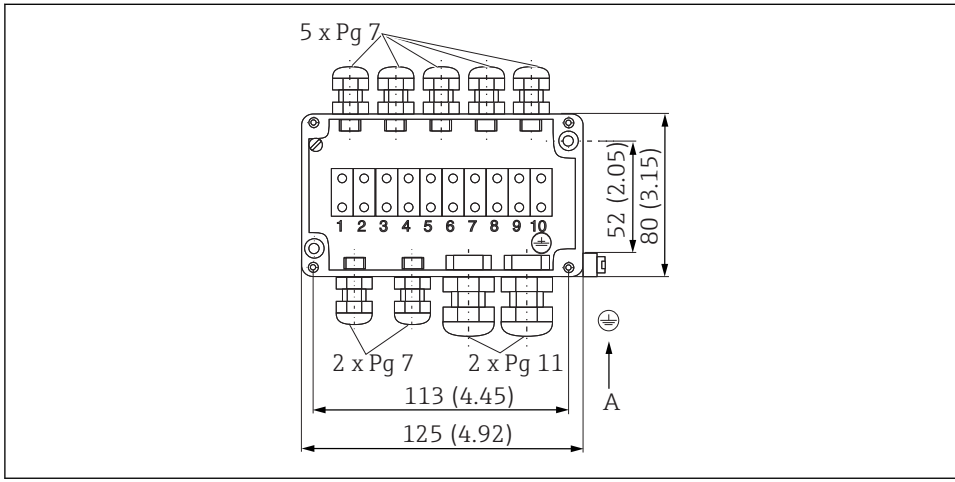
*7 Sensor with TOP68 plug-in head and CPK9 measuring cable with internal PAL (CPK9-N*A1B)*

1 *Signal (cathode) (black coax)*
2 *Reference (anode) (screened coax)*
3 *Not used (white)*
4 *Temperature sensor (green)*
5 *Temperature sensor (yellow)*
6 *Not used (brown)*

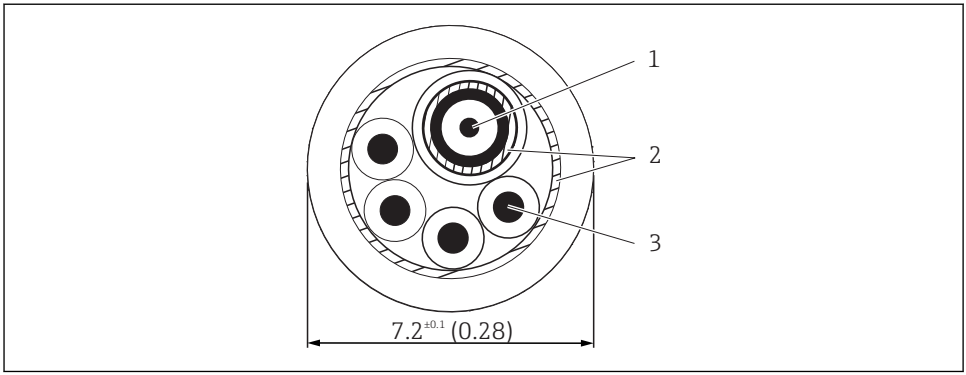
6.1.1 Connecting the cable extension

To extend the sensor connection, use the VBC junction box.

Extend the connections as follows:
- Chlorine sensor with measuring cable CYK71
- pH and ORP sensors measuring cable CYK71
- Inductive proximity switch with measuring cable MK



8 VBC junction box with grounding option, specifications in mm (in)



9 Structure of measuring cable CYK71, specifications in mm (in)

1 Coax, e.g. pH, ORP
2 Shielding
3 4 control lines YE/GN/WH/BN

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) that are loose or insufficiently secured.

6.3 Post-connection check

Device condition and specifications	**Notes**
Are the sensor, assembly, junction box, or cables free from damage on the outside?	Visual inspection
Electrical connection	**Notes**
Are the mounted cables strain-relieved and not twisted?	
Is a sufficient length of the cable cores stripped, and are the cores positioned in the terminal correctly?	Check the fit (by pulling gently)
Are all the screw terminals properly tightened?	Tighten
Are all the cable entries installed, tightened and sealed?	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 Commissioning

7.1 Function check

Prior to initial commissioning, ensure that:
- The sensor is correctly installed
- The electrical connection is correct.
- There is sufficient electrolyte in the membrane cap and the transmitter is not displaying a warning about electrolyte depletion.

Please note the information on the safety data sheet to ensure safe use of the electrolyte.

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.
- ▶ Do not install the assembly in the process if you cannot reliably establish the correct connection.

7.2 Sensor polarization

The voltage applied by the transmitter between cathode and anode polarizes the surface of the working electrode. Therefore, after switching on the transmitter with the sensor connected, you must wait until the polarization period has elapsed before starting calibration.

To achieve a stable display value, the sensor requires the following polarization periods:

Initial commissioning

CCS140	60 minutes
CCS141	90 minutes

Recommissioning

CCS140	30 minutes
CCS141	45 minutes

7.3 Sensor calibration

Reference measurement according to the DPD method

To calibrate the measuring system, carry out a colorimetric comparison measurement in accordance with the DPD method. Chlorine reacts with diethyl-p-phenylendiamine (DPD) producing a red dye, the intensity of the red color being proportional to the chlorine content. Measure the intensity of the red color using a photometer (e. g. PF-3→ 33) . The photometer indicates the chlorine content.

Requirements

The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally guaranteed once the following preconditions have been met:

- The polarization period has elapsed.
- The flow is constant and within the correct range.
- The sensor and the medium are at the same temperature.
- The pH value is within the permitted range.

Zero point adjustment

A zero point adjustment is not required due to the zero point stability of the membrane-covered sensor.
However, a zero point adjustment can be performed if desired.

1. To perform a zero point adjustment, operate the sensor for at least 15 min. in chlorine-free water, using the assembly or protection cap as a vessel.
2. Alternatively, perform the zero point adjustment using the zero point gel COY8→ 🖹 33.

Slope calibration

Always perform a slope calibration in the following cases:
- After replacing membrane
- After replacing electrolyte

1. Ensure that the pH value and temperature of the medium are constant.
2. Take a representative sample for the DPD measurement. This must be done in close proximity to the sensor. Use the sampling tap if available.
3. Determine the chlorine content using the DPD method.
4. Enter the measured value into the transmitter (see Operating Instructions for transmitter).
5. To ensure greater accuracy, check the calibration several hours or 24 hours later using the DPD method.

8 Diagnostics and troubleshooting

When troubleshooting, you must take account of the entire measuring system. This comprises:
- Transmitter
- Electrical connections and lines
- Assembly
- Sensor

The possible causes of error in the following table refer primarily to the sensor. Before commencing troubleshooting, ensure that the following operating conditions have been met:
- Constant pH value after calibration, not required for measurement in "pH-compensated" mode
- Constant temperature after calibration, not required for measurement in "temperature-compensated" mode
- Medium flow rate of at least 30 l/h (7.9 gal/h) (red bar mark when using the CCA250 flow assembly)
- No use of organic chlorination agents

If the value measured by the sensor differs significantly from that of the DPD method, you should first consider all possible malfunctions of the photometric DPD method (see Operating Instructions for photometer). If necessary, repeat the DPD measurement several times.

Error	Possible cause	Remedy
No display, no sensor current	No supply voltage at the transmitter	▶ Establish mains connection
	Connection cable between sensor and transmitter interrupted	▶ Establish cable connection
	Measuring chamber is not filled with electrolyte	▶ Fill measuring chamber (→ 🖹 27)
	No input flow of medium	▶ Establish flow, clean filter
Display value too high	Polarization of the sensor not yet completed	▶ Wait for polarization to be completed
	Membrane defective	▶ Replace membrane cap
	Shunt resistance (e.g. moisture contact) in the sensor shaft	▶ Open measuring chamber, rub gold cathode dry. If the transmitter display does not return to zero, there is a shunt present.
	Foreign oxidants interfering with sensor	▶ Examine medium, check chemicals

Error	Possible cause	Remedy
Display value too low	Measuring chamber not completely tightened	▶ Fully tighten measuring chamber or screw cap
	Membrane soiled	▶ Clean membrane
	Air bubble in front of membrane	▶ Release air bubble
	Air bubble between cathode and membrane	▶ Open measuring chamber, top up electrolyte, tap
	Input flow of medium too low	▶ Establish correct flow (→ 🖹 8)
	Foreign oxidants interfering with DPD reference measurement	▶ Examine medium, check chemicals
	Use of organic chlorination agents	▶ Use agents according to DIN 19643 (water may need to be replaced beforehand)
Display fluctuates considerably	Hole in membrane	▶ Replace membrane cap
	External voltage in medium	▶ Measure voltage between the PML pin and the protective ground of the measuring device (both AC and DC ranges). For values greater than approx. 0.5 V, find and eliminate external cause.
Temperature reading is too low	Supply line to NTC temperature sensor interrupted	1. Perform line test (fixed cable: green/brown, TOP68: green/yellow) and resistance measurement (NTC). 2. Where applicable, change sensor.
Temperature reading is too high	Short-circuit in supply line to NTC temperature sensor	1. Perform line test (fixed cable: green/brown, TOP68: green/yellow) and resistance measurement (NTC). 2. Where applicable, change sensor.

9 Maintenance

Please note the information on the safety data sheet to ensure safe use of the electrolyte.

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

1. Check the measurement at regular intervals; depending on the prevailing conditions, **at least once a month**.
2. Clean the sensor if the membrane is visibly soiled ((→ 25)).
3. Replace the electrolyte **once per season or every 12 months** or depending on the chlorine content on site.
4. Calibrate the sensor if desired or when necessary ((→ 21)).

9.2 Maintenance tasks

9.2.1 Cleaning the sensor

CAUTION

Diluted hydrochloric acid

Hydrochloric acid causes irritation if it comes into contact with the skin or eyes.

- When using diluted hydrochloric acid, wear protective clothing such as gloves and goggles.
- Avoid splashes.

NOTICE

Chemicals that reduce surface tension

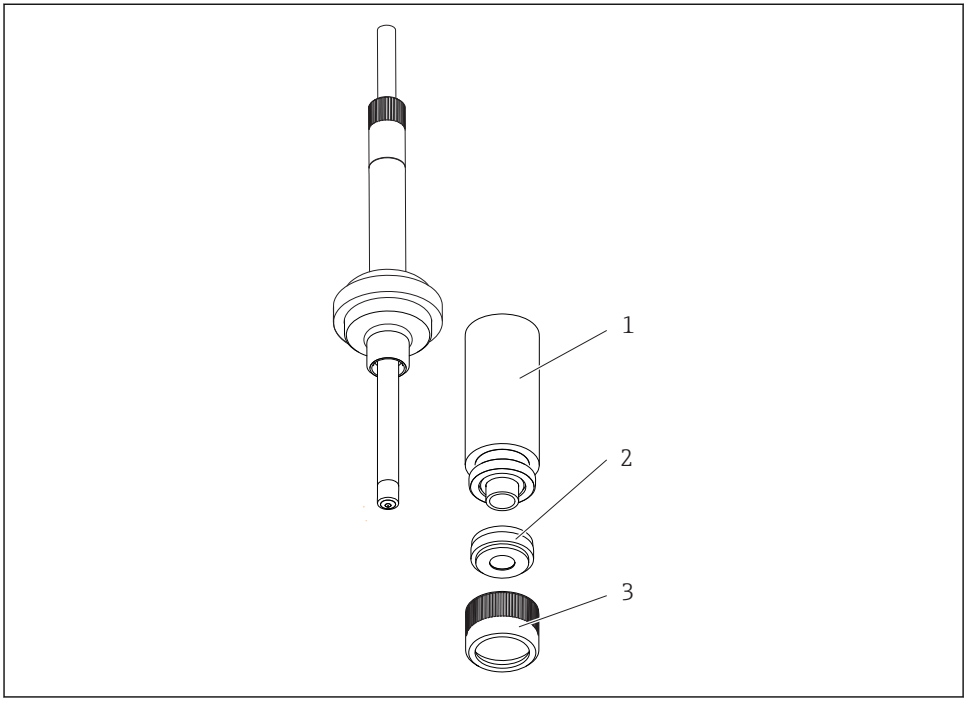
Chemicals that reduce surface tension can penetrate the sensor membrane and cause measuring errors due to clogging.

- Do not use any chemicals that reduce surface tension.

If the membrane is visibly soiled, proceed as follows:

1. Remove sensor from flow assembly.
2. Clean the membrane by mechanical means only, using a gentle water jet. Alternatively, place it for several minutes in 1 to 5% hydrochloric acid without any other chemical additives.
3. If cleaning in hydrochloric acid, rinse off the hydrochloric acid with plenty of water.

9.2.2 Replacing the membrane



10 Replacing the membrane

1 Measuring chamber
2 Membrane cap
3 Screw cap

1. Unscrew the measuring chamber (1).
2. Unscrew the front screw cap (3).
3. Remove the membrane cap (2) and replace it with a CCY14-WP replacement cartridge.
4. Refill the measuring chamber with electrolyte CCY14-F(→ 27).

9.2.3 Refilling the electrolyte

NOTICE

Damage to membrane and electrodes, air bubbles

Possibility of measured errors to complete failure of the measuring point

- ▶ Do not touch the membrane or electrodes. Avoid damaging them.
- ▶ The electrolyte is chemically neutral and is not hazardous to health. Nonetheless, do not swallow it and avoid contact with eyes.
- ▶ Keep the electrolyte bottle closed after use. Do not transfer electrolyte to other vessels.
- ▶ Do not store electrolyte for longer than 2 years. The electrolyte must not be yellow in color. Observe the use-by date on the label.
- ▶ Avoid air bubbles when pouring electrolyte into the membrane cap.

1. Unscrew the measuring chamber from the shaft.
2. Hold the measuring chamber at an angle and pour in approx. 7 to 8 ml (0.24 to 0.27 fl.oz) of electrolyte, up to the internal thread.
3. Tap the filled chamber several times against a flat surface so that adherent air bubbles on the inside can detach and rise.
4. Insert the sensor shaft vertically into the measuring chamber.
5. Slowly tighten the measuring chamber to the stop. While tightening, excess electrolyte is forced out at the bottom of the sensor.
6. If necessary, use a cloth to wipe the measuring chamber and screw cap dry.

9.2.4 Storing the sensor

If measurement is suspended for a short period of time and it can be guaranteed that the sensor will be kept moist while in storage:

1. If the assembly is guaranteed not to empty out,
   you may leave the sensor in the flow assembly.
2. If there is a possibility that the assembly may empty out,
   Remove sensor from assembly .
3. To keep the membrane moist after the sensor has been removed, refill the protection cap with electrolyte or clean water.
4. Fit protection cap on sensor → 🖹 28.

During longterm interruptions to measurement, particularly if dehydration is possible:

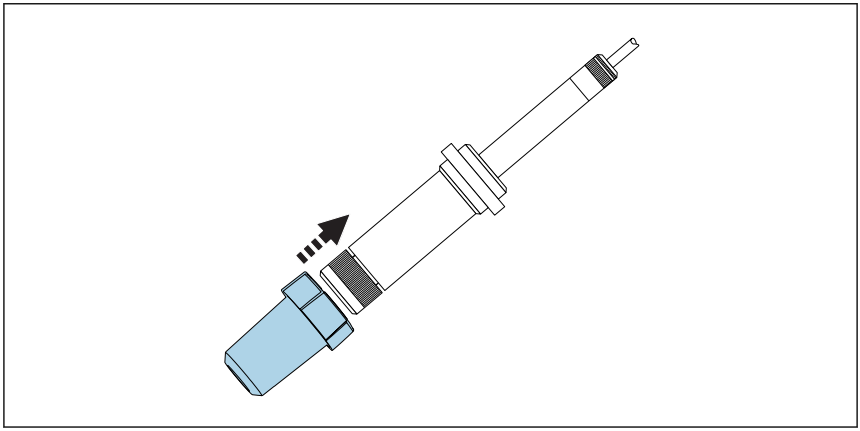
1. Remove sensor from assembly.
2. Clean sensor shaft and membrane cap with cold water and leave to dry.
3. Loosely screw on membrane cap up to the stop. This ensures that the membrane remains slack.
4. Pour electrolyte or clean water into protection cap and attach → 🖹 27.

5. For recommissioning, follow the same procedure as for commissioning → 21.

Ensure that no biofouling occurs during longer interruptions to measurement. Remove continuous organic deposits such as films of bacteria.

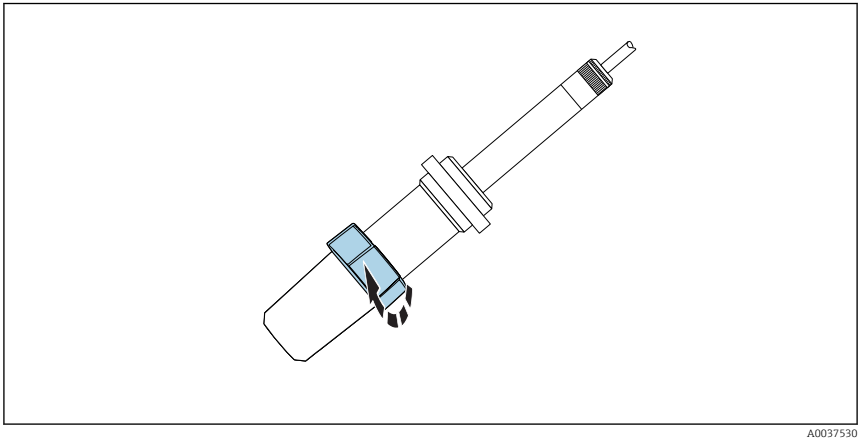
Fit protection cap on sensor.

1. To keep the membrane moist after the sensor has been removed, refill the protection cap with electrolyte or clean water.



11 *Carefully slide protection cap onto the membrane cap.*

2. Top part of protection cap is in the open position.
   Carefully slide protection cap onto the membrane cap.
3. Secure protection cap by rotating the top part of the protection cap.



12 *Securing protection cap by rotating the top part*

9.2.5 Regenerating the sensor

During measurement, the electrolyte in the sensor is gradually exhausted due to chemical reactions. The gray-brown silver chloride layer that is applied to the anode at the factory continues to grow during sensor operation. However, this has no effect on the reaction taking place at the cathode.

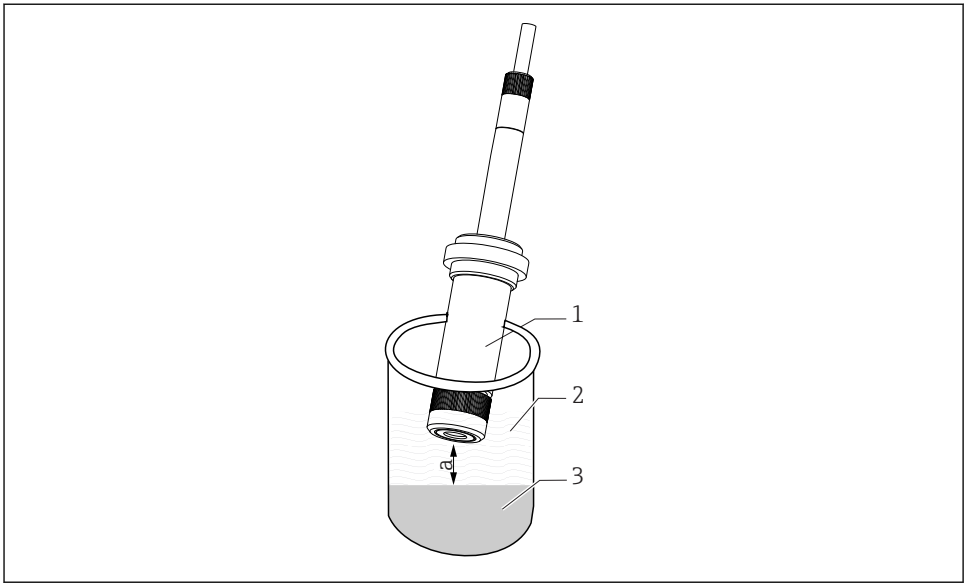
A change in the color of the silver chloride layer indicates an effect on the reaction that is taking place. Carry out a visual inspection to ensure that the gray-brown color of the anode has not changed. If the color of the anode has changed, e.g. if it is spotted, white or silvery, the sensor must be regenerated.

▶ Send the sensor to the manufacturer for regeneration.

9.2.6 Reconditioning the sensor

Longterm operation of the sensor (> 3 months) in a chlorine-free medium, i.e. with very low sensor currents, may lead to deactivation of the sensor. This deactivation is a continuous process that results in a lower slope and longer response times. After long-term operation in a chlorine-free medium, the sensor can be reconditioned.

The following materials are required for reconditioning:
- Deminieralized water
- Polishing sheet (→ 🖹 34)
- Beaker
- Pour approx. 100 ml (3.38 fl.oz) Chlorine bleach NaOCl, approx. 13 %, pharmaceutical quality (available at chemical stores or pharmacies)



A0037414

1 Sensor
2 Gaseous phase of chlorine bleach lye
3 Chlorine bleach lye
a Distance between sensor and liquid, 5 to 10 mm (0.2 to 0.4 in)

1. Close the medium inlet and outlet and make sure that no medium can escape from the assembly.
2. Remove sensor from assembly .
3. Unscrew measuring chamber and set aside.
4. Polish the sensor's gold cathode using the polishing sheet: Place a wetted strip of the sheet in your hand, polish the gold cathode on the strip using circular movements, and rinse the sensor with deionized water.
5. If necessary:
   Top up the electrolyte in the measuring chamber and screw the measuring chamber back onto the sensor shaft.
6. Fill the beaker to approx. 10 mm (0.4 in) with chlorine bleach and put in a safe place.
7. The sensor must not touch the liquid.
   Place the sensor in the gas phase approx. 5 to 10 mm (0.2 to 0.4 in) above the chlorine bleach.
   ↳ The sensor current will now increase. The absolute value and the rate of increase depend on the temperature of the chlorine bleach.
8. When the sensor current has reached a value of several hundred nA:
   Leave the sensor in this position for approx. 20 minutes.

9. If the value of several hundred nA is not reached:
   Cover the beaker to avoid a rapid exchange of air.
10. Once the 20 minutes have elapsed, re-install the sensor in the assembly.
11. Open the medium inlet and outlet again.
    ↳ The sensor current will now normalize.

After allowing sufficient settling time (no noticeable drift), calibrate the measuring chain.

10 Repair

10.1 Spare parts

For more detailed information on spare parts kits, please refer to the "Spare Part Finding Tool" on the Internet:

www.endress.com/spareparts_consumables

10.1.1

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:

- Refer to the website www.endress.com/support/return-material for information on the procedure and conditions for returning devices.

10.3 Disposal

The device contains electronic components. The product must be disposed of as electronic waste.

- Observe the local regulations.

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

VBC junction box
- For cable extension (for chlorine measuring systems)
- Dimensions (B x D x H): 125 x 80 x 54 mm (4.92 x 3.15 x 2.13 ")
- 10 terminal strips
- Cable entries: 7 x Pg 7, 2 x Pg 11
- Material: aluminum
- Degree of protection: IP65 (i NEMA 4x)
- Order No. 50005181

Measuring cable CYK71
- Unterminated cable for connecting analog sensors and for extending sensor cables
- Sold by the meter, order numbers:
  - Non-Ex version, black: 50085333
  - Ex-version, blue: 50085673

Measuring cable CPK9
- Terminated measuring cable for connecting analog sensors with TOP68 plug-in head
- Selection in accordance with product structure
- Ordering information: Endress+Hauser sales office or www.endress.com.

MK extension cable
- Twin-core signal cable with additional shielding and PVC insulation
- Preferably for the transmission of output signals from transmitters or input signals from controllers and for temperature measurement.
- Order number: 50000662

Flowfit CCA250
- Flow assembly for chlorine and pH/ORP sensors
- Product Configurator on the product page: www.endress.com/cca250

Technical Information TI00062C

Photometer PF-3
- Compact hand-held photometer for determining free available chlorine
- Color-coded reagent bottles with clear dosing instructions
- Order No.: 71257946

Compact measuring station CCE10/CCE11
- Fully assembled and wired panel for one or three transmitters, with CCA250-A1 flow assembly
- Product Configurator on the product page: www.endress.com/cce10 or www.endress.com/cce11

Technical Information TI00440C

COY8
Zero-point gel for oxygen and chlorine sensors
- Oxygen-free gel for the validation, calibration and adjustment of oxygen measuring cells
- Product Configurator on the product page: www.endress.com/coy8

Technical Information TI01244C

Service kit CCS14x
- For chlorine sensors CCS140 / CCS141 / CCS142D
- 2 replacement cartridges, electrolyte 50 ml (1.69 fl.oz), sanding sheets
- Order No. 71076921

Polishing sheet COY31-PF
- For oxygen and chlorine sensors
- 10 pieces for cleaning gold cathode
- Order No. 51506973

12 Technical data

12.1 Input

12.1.1 Measured values

Free chlorine (HOCl) — Hypochlorous acid (HOCl)
[mg/l, µg/l, ppm, ppb]

12.1.2 Measuring ranges

CCS140-* (for industrial water, bathing water)	0.05 to 20 mg/l (ppm) Cl_2
	(at 25 °C (77 °F), pH 7.2)
CCS141-* (for drinking water applications)	0.01 to 5 mg/l (ppm) Cl_2
	(at 25 °C (77 °F), pH 7.2)

12.1.3 Signal current

CCS140-*	Approx. 25 nA per mg/l Cl_2 (at 25 °C (77 °F), pH 7.2)
CCS141-*	Approx. 80 nA per mg/l Cl_2 (at 25 °C (77 °F), pH 7.2)

12.2 Performance characteristics

12.2.1 Reference operating conditions

25 °C (77 °F)

pH 7.2

12.2.2 Response time

T_{90} < 2 minutes

in applications involving mainly active chlorination

12.2.3 Long-term drift

< 1.5 % per month

12.2.4 Polarization time

	Initial commissioning	Recommissioning
CCS140-*	60 min	30 min
CCS141-*	90 min	45 min

12.3 Environment

12.3.1 Ambient temperature range

−5 to 55 °C (20 to 130 °F)

12.3.2 Storage temperature

With electrolyte	5 to 50 °C (40 to 120 °F)
Without electrolyte	−20 to 60 °C (−4 to 140 °F)

12.3.3 Degree of protection

IP68 IP (up to mounting collar Ø 36 mm (1.42"))

12.4 Process

12.4.1 Process temperature

CCS140

10 to 45 °C (50 to 113 °F)

CCS141

2 to 45 °C (36 to 113 °F)

12.4.2 Process pressure

max. 1 bar (14.5 psi) absolute, if installed in the Flowfit CCA250 assembly

12.4.3 pH range

At average medium concentrations of 1 mg/l (ppm) Cl_2 and under reference conditions

Calibration	
CCS140-*	pH 4 to 8
CCS141-*	pH 4 to 8.2
Measurement	pH 4 to 9

Chlorine measurement possible up to pH 9 with limited accuracy

12.4.4 Flow

At least 30 l/h (7.9 gal/h), in the CCA250 assembly

12.4.5 Minimum flow

At least 15 cm/s (0.5 ft/s)

12.5 Mechanical construction

12.5.1 Dimensions

→ 14

12.5.2 Weight

Approx. 500 g (1.1 lbs)

12.5.3 Materials

Sensor shaft	PVC
Membrane	PTFE
Membrane cap	PBT (GF 30), PVDF
Cathode	Gold
Anode	Silver/silver chloride

12.5.4 Cable specification

max. 3 m (9.84 ft)

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