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Operating Instructions
CPSx1, CPFx1 pH sensors
CPSx2, CPFx2 ORP sensors

pH and ORP measurement
Analog sensors



Endress+Hauser
People for Process Automation

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1 About this document

1.1 Safety information

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

1.2 Symbols

- Additional information, tips
- Permitted
- Recommended
- Not permitted or not recommended
- Reference to device documentation
- Reference to page
- Reference to graphic
- Result of an individual step

1.2.1 Symbols on the device

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

1.3 Documentation

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

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

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

Special Documentation for hygienic applications, SD02751C

Safety instructions for electrical apparatus in hazardous area, analog pH/ORP sensors, XA00028C

Safety instructions for electrical apparatus in hazardous area, analog pH/ORP sensors, XA03597C

Safety instructions for electrical apparatus in hazardous area, analog pH/ORP sensors, XA03537C

Safety instructions for electrical apparatus in hazardous area, analog pH/ORP sensors, XA02785C

2 Basic safety instructions

2.1 Requirements for the personnel

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

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

2.2 Intended use

The CPSx1 CPFx1 pH sensors are designed for the continuous measurement of the pH value in liquids.

The CPSx2 and CPFx2 sensors are designed for the measurement of the oxidation-reduction potential (ORP) in liquids.

Together with the CPSx3 reference half-cells, the CPSx4 and CPSx5 half-cells are designed for the measurement of the pH value (CPSx4) or the ORP (CPSx5) in liquids.

A list of recommended applications is provided in the Technical Information for the relevant sensor.

Any use other than that intended puts the safety of people and the measuring system at risk. Therefore, any other use is not permitted.

The manufacturer is not liable for harm caused by improper or unintended use.

2.3 Workplace safety

The operator is responsible for ensuring compliance with the following safety regulations:
- Installation guidelines
- Local standards and regulations
- Regulations for explosion protection

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.

Procedure for damaged products:

1. Do not operate damaged products, and protect them against unintentional operation.
2. Label damaged products as defective.

During operation:

▶ If errors cannot be rectified,
take products out of service and protect them against unintentional operation.

2.5 Product safety

2.5.1 State-of-the-art technology

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

3 Incoming acceptance and product identification

3.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

3.2 Product identification

3.2.1 Nameplate

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

▶ Compare the information on the nameplate with the order.

3.2.2 Identifying the product

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. Page search (magnifying glass symbol): Enter valid serial number.
3. Search (magnifying glass).
   ↳ The product structure is displayed in a popup window.
4. Click the product overview.
   ↳ A new window opens. Here you will find information pertaining to your device, including the product documentation.

3.2.3 Manufacturer address

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

or

Endress+Hauser Conducta Inc.
4123 East La Palma Avenue, Suite 200
Anaheim, CA 92807 USA

3.3 Storage and transport

NOTICE

Freezing of internal buffer and inner electrolyte!
The sensors can crack at temperatures lower than -15 °C (5 °F).
- ▶ If transporting the sensors, make sure to package them so they are appropriately protected against frost.

All sensors are individually tested and supplied in individual packs. The sensors are fitted with a wetting cap. The cap contains a KCl-containing liquid that prevents the sensor from drying out. The liquid does not need to cover the pH glass membrane. The 100% humidity inside the cap is sufficient to keep the sensor ready for measurement.

- ▶ If a wetting cap is not used to store the sensor, store the sensor in a KCl solution (3 mol/l) or in a salt-enriched buffer solution (preferably CPY20 pH 7).

Do not allow the sensor to dry out, This can lead to permanent measurement errors or sensor failure.

Sensors must be stored in dry rooms at temperatures of 0 to 50 °C (32 to 122 °F).

3.4 Scope of delivery

The scope of delivery comprises:
- Ordered version of the sensor
- Operating Instructions
- Safety instructions for the hazardous area (for sensors with Ex approval)
- Supplementary sheet for optionally ordered certificates

3.5 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

4 Installation

4.1 Installation requirements

Follow the Operating Instructions for the assembly used for detailed information on installing the assembly.

1. Before screwing in the sensor, make sure the assembly thread, the O-rings and the sealing surface are clean and undamaged and that the thread runs smoothly.
2. Hand-tighten the sensor with a torque of 3 Nm (2.21 lbf ft) (Only applies when installing in Endress+Hauser assemblies).

4.1.1 Orientation

⚠ CAUTION

Pressurization of sensor due to prolonged use under increased process pressure

Possibility of sudden rupture and injury from glass splinters!

- ▶ Avoid fast heating of these pressurized sensors if they are used under reduced process pressure or under atmospheric pressure.
- ▶ When handling these sensors, always wear protective goggles and appropriate protective gloves.

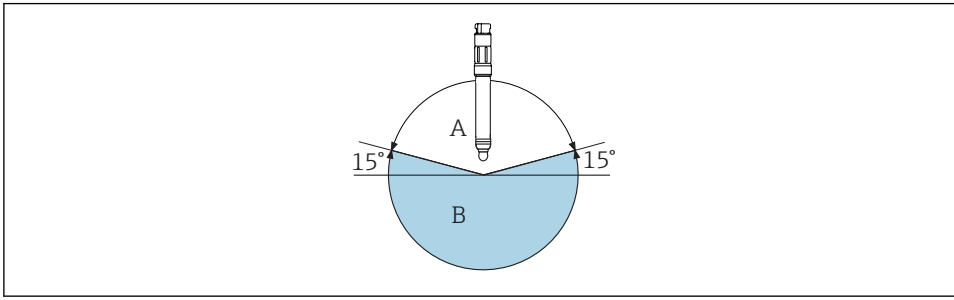
⚠ CAUTION

Glass sensor with pressurized reference

Possibility of sudden rupture and injury from glass splinters!

- ▶ When handling these sensors, always wear protective goggles and appropriate protective gloves.

- Do not install the sensors upside-down.
- The angle of inclination from the horizontal must be at least 15°.

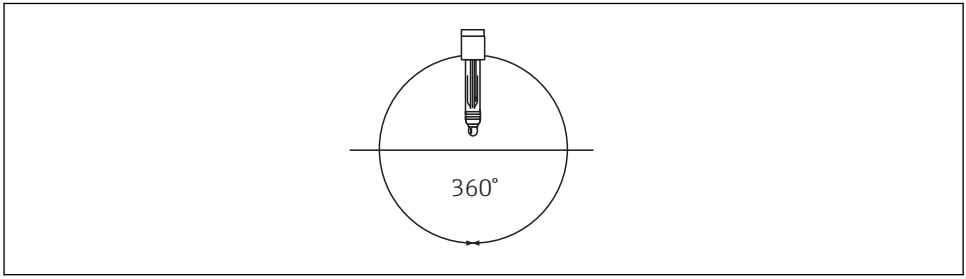


A0028039

1 *Installation angle at least 15° from the horizontal*

A Permitted orientation
B Incorrect orientation

Orientation of sensors for upside-down installation:
- The sensors are suitable for upside-down installation according to the "Reference system" order code [1].
- Install the sensors at any angle.



2 Any installation angle

4.2 Post-installation check

Put the sensor into operation only if you can answer "yes" to the following questions:
- Are the sensor and cable undamaged?
- Is the orientation correct?

1) Upside-down installation is also possible for ORP and reference half-cells with a solid gel.

5 Electrical connection

WARNING

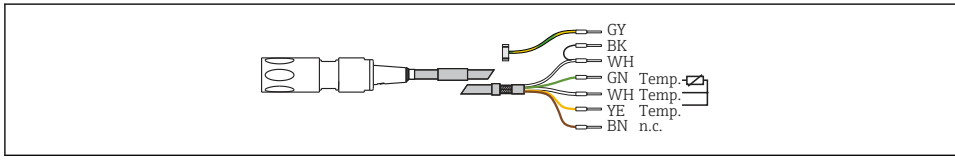
Device is live!

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.

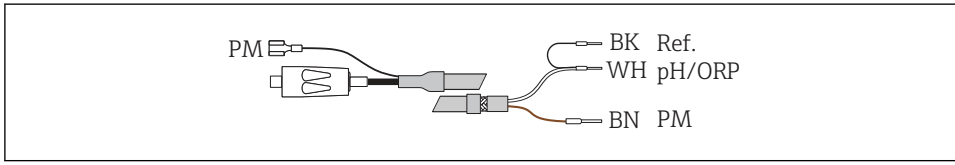
5.1 Connecting the sensor

Sensors with TOP68 plug-in head



3 Measuring cable CPK9

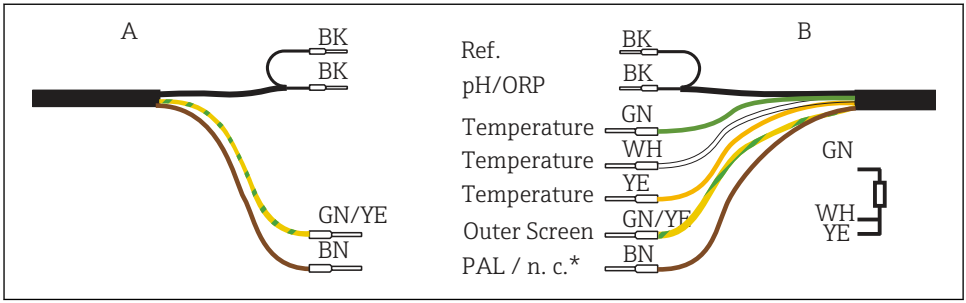
Sensors with GSA plug-in head



4 Measuring cable CPK1

- Please follow the connection instructions contained in the Operating Instructions for the transmitter.

5.1.1 CPF81 and CPF82 with fixed cable



5 Fixed cable connection

A Fixed cable CPF81 without temperature sensor and CPF82
B Fixed cable CPF81 with temperature sensor
** The PML is connected only in the case of sensor versions with an internal PML (CPF81-xxx2xx)*

6 Commissioning

6.1 Preliminaries

NOTICE

If, for temporary storage, the protective cap is refitted on a moist sensor, KCl may crystallize out. This can lead to the cap drying out.

► Ensure that the sensor is dry when the protective cap is fitted.

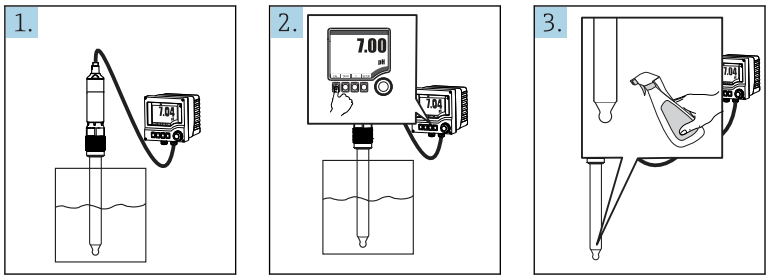
6.1.1 Calibration and adjustment

The frequency at which sensor adjustment or sensor inspection is performed depends on the operating conditions, e.g. fouling and chemical load.

- Two-point calibration is required for pH sensors. Use quality buffers from Endress+Hauser, e.g. CPY20, for this purpose.
- One-point calibration is required for ORP sensors. Use a buffer solution with 220 mV or 468 mV from Endress+Hauser, e.g. CPY3, for this purpose.

► Remove protective cap from sensor.

Calibrating and adjusting ORP sensors:



1. pH/ORP sensors which are stored dry must be immersed in medium for at least 24 hours before use. Otherwise severe value drifting can be expected.
2. Immerse the sensor in a defined buffer solution (e.g. 220 mV) (1).
3. Rinse the sensor with water and dry carefully.
4. Perform the calibration at the transmitter (2):

(a) Enter the mV value of the buffer solution.

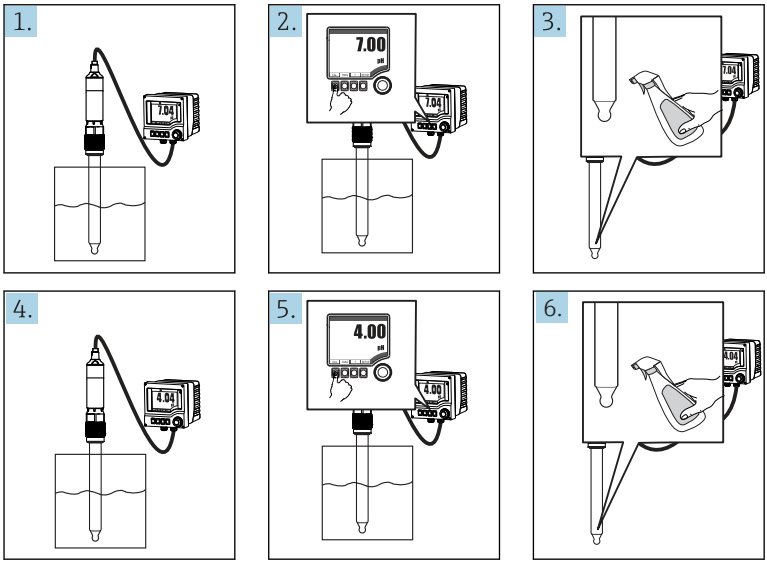
(b) Start the calibration.

(c) The value is accepted once it has stabilized.

5. Rinse the sensor with distilled water (3). Dry the sensor carefully.

The use of automatic temperature compensation (ATC) is recommended for calibration and measurement.

Calibrating and adjusting pH sensors:



1. Immerse the sensor into a defined buffer solution (e.g. pH 7 or another pH buffer value).

2. Perform the calibration at the transmitter:

(a) Enter the pH value.

(b) Start the calibration.

(c) The value is accepted once it has stabilized.

3. Rinse the sensor with distilled water. Do not dry the sensor!

4. Immerse the sensor into the second buffer solution (e.g. pH 4).

5. Perform the calibration at the transmitter:

(a) Start the calibration.

(b) The value is accepted once it has stabilized.

6. Rinse the sensor with distilled water.

The use of automatic temperature compensation (ATC) is recommended for calibration and measurement.

The transmitter calculates the zero point and slope and displays the values. The sensor is adjusted once the values are accepted.

7 Maintenance

7.1 Maintenance tasks

7.1.1 Cleaning the sensor

⚠ WARNING

Mineral acids

Risk of serious or fatal injury from caustic burns!

- ▶ Wear goggles to protect eyes.
- ▶ Wear protective gloves and appropriate protective clothing.
- ▶ Avoid all contact with the eyes, mouth and skin.

⚠ WARNING

Thiocarbamide

Harmful if swallowed! Limited evidence of carcinogenicity! Possible risk of harm to the unborn child! Dangerous for the environment with long-term effects!

- ▶ Wear protective goggles, protective gloves and appropriate protective clothing.
- ▶ Avoid all contact with the eyes, mouth and skin.
- ▶ Avoid discharge into the environment.

⚠ CAUTION

Corrosive chemicals

Risk of chemical burns to the eyes and skin and risk of damage to clothing and equipment!

- ▶ It is absolutely essential to protect the eyes and hands properly when working with acids, alkalis and organic solvents!
- ▶ Wear protective goggles and safety gloves.
- ▶ Clean away splashes on clothes and other objects to prevent any damage.
- ▶ Comply with instructions in the safety data sheets for the chemicals used.

Possible cleaning aids:

- Brush with soft bristles
- Soft cloth
- Sponge

- ▶ First rinse the sensor with clean water to remove liquid residues.

In case of fouling and deposits:

1. Clean the sensor with a solution of detergent and warm water.
2. Carefully scrub the sensor with a soft brush.
3. Rinse the sensor thoroughly with warm tap water.

Clean away fouling on the sensor as follows depending on the type of fouling:

1. Oily and greasy films:
   Clean with grease remover, e.g. alcohol, or hot water with an alkaline agent.

2. Lime and metal hydroxide buildup and low solubility (lyophobic) organic buildup:
   Dissolve buildup with diluted hydrochloric acid (3 %) and then rinse thoroughly with plenty of clear water.
3. Sulfidic buildup (from flue gas desulfurization or wastewater treatment plants):
   Use a mixture of hydrochloric acid (3 %) and thiocarbamide (commercially available) and then rinse thoroughly with plenty of clear water.
4. Buildup containing protein (e.g. in the food industry):
   Use a mixture of hydrochloric acid (0.5 %) and pepsin (commercially available) and then rinse thoroughly with plenty of clear water.
5. Readily soluble biological buildup:
   Rinse with pressurized water.

After cleaning, rinse the sensor thoroughly with plenty of water and then recalibrate it.

After cleaning:

1. Rinse the sensor thoroughly with water.
2. Regenerate the sensor. To do so, immerse the sensor overnight in a 3 mol KCl solution (e.g. CPY4*).

pH

Type of contamination	Cleaning agent
Grease and oil	Substances containing surfactants (alkaline) or water-soluble organic solvents (e.g. alcohol)
Iron deposits	Oxalic acid (3%)
Limestone deposits, metal hydroxide deposits, heavy biological deposits	HCl (3 %)
Sulfide deposits	Mixture of HCl (3%) and thiocarbamide
Protein deposits	Pepsin is a digestive enzyme for proteins and works very well at a pH value of 2 (± 0.5). Possible mixture: HCl (0.01 molar) and 0.5-2% pepsin, adjust to pH 2.
Fibers, suspended solids	Pressurized water, possibly with surfactants
Light biological deposits	Pressurized water

ORP

- For platinum: Use a soft brush or sponge for cleaning.
- For gold: Use a soft cloth for cleaning.

ORP sensors should only be cleaned mechanically. During chemical cleaning, a voltage is applied to the electrode that requires several hours to dissipate. This can lead to measurement errors.

8 Repair

8.1 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.

www.endress.com/support/return-material

8.2 Disposal

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

▶ Observe the local regulations.



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

9 Accessories



For detailed information on accessories, see the "Technical Information" for the relevant sensor.

10 Technical data



For detailed information on technical data, see the "Technical Information" for the relevant sensor.

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