F3 & D3 Self Cleaning Disinfectant Sensor Instructions

Rev. 9/12/2022

2.1 Product description

The F3 & D3 sensors are 3-electrode systems without covering membranes for measurement of the disinfectants chlorine (F3) or chlorine dioxide (D3) dissolved in water. These sensors are characterized by the ability to operate at high pressures. In addition, D3 sensors can be used when the water being measured is at high temperatures. The area of application of these sensors comprises water with qualities similar to those of drinking water, especially at high pressures and/or high temperatures. The sensors are fitted as standard with a retaining ring.

The sensors are not suitable for checking the absence of chlorine or chlorine dioxide.

2.1.1 Chlorine

The F3 sensor measures the concentration of free chlorine in the water being measured, resulting from the application of inorganic chlorine products (such as chlorine gas, sodium hypochlorite solution, calcium hypochlorite solution).

The sensor can be used in the pH range from pH 5.0 to pH 9.0. It is essential to keep the pH value at a constant level, since the sensor signal is pH-dependent. The sensor shows different chlorine values different values depending on the pH value although no change in the chlorine concentration can be recognized in the DPD-1 measuring values.

2.1.2 Chlorine dioxide

The D3 sensor measures the concentration of chlorine dioxide in the water being measured, resulting from the application of chlorine dioxide (created for example by the acid/chlorite process, chlorine/chlorite process). The chlorine dioxide sensor is virtually insensitive to chlorine.

2.1.3 Cleaning head device

The cleaning device ensures continuous automatic mechanical cleaning of the surfaces of the electrodes. This extends the maintenance intervals, because the signals from the sensors remain stable over a longer period.
The use of the cleaning head device reduces the nominal measuring range due to signal amplification.

3.1 Use for the intended purpose

The sensor is intended to be used for measuring the concentration of a specific disinfectant in water.
The sensor may be used only under the following conditions:

- For the disinfectant specified in the respective data sheet.
- Under the conditions of use specified on the respective data sheet.
- Upright installation in a suitable flow chamber
- Restricted to the activities described in these operating instructions.
- Use only when in fault-free condition.
- Use of original accessories and spare parts.

3.2 Use other than for the intended purpose
The sensor may not be used for measurements to demonstrate the absence of the disinfectant.

3.3 Handling Impacts, shocks and improper touching
Impacts or shaking of the sensor, such as by dropping it, can damage it.

- Avoid impacts and shocks.
- Do not allow the sensor to be dropped.
- Touching the reference electrode, or using emery paper on it, can damage it.
- Do not touch the reference electrode.
- Do not remove the reference cartridge.
- During maintenance work, use emery paper only on the working electrode/counter electrode as necessary, not on the reference electrode.

3.4 Electrical interference
A lack of galvanic isolation can falsify the measuring value and even damage the sensor beyond repair.

- Ensure the electrical connection has galvanic isolation.
- Electrical interference on the signal lead can damage the electronics.
- Ensure the connection is made correctly.

3.5 Lack of disinfectant
If for a prolonged period there has been no disinfectant in the water, a film of biological matter may accumulate on the electrodes. This falsifies the measured value and means maintenance must be performed on the sensor (see section 7.2).

- Make sure that the period during which there is no disinfectant present is no longer than specified on the data sheet.

3.5.6 Loss of measuring values when the sensor is removed
After the sensor has been removed there is no longer a measuring value, which can lead to incorrect dosing of the disinfectant.

- Switch off the measurement and control system or switch it over to manual operation.

3.5.7 Oxidants, reducers and corrosion inhibitors
Oxidants, reducers and corrosion inhibitors in the water interfere with measurement and can lead to measuring errors.

- Make sure there are no oxidants, reducers or corrosion inhibitors in the water.
- Comply with the instructions on the data sheet.

3.5.8 pH value (only chlorine)
If the pH value in the water changes or if the pH value lies outside the permissible range the measuring value can be falsified.

- Make sure that the pH value lies within the permissible range.
- Make sure that the pH value is kept constant.
- Comply with the instructions on the data sheet.

3.5.9 Temperature and fluctuations in temperature

If the ambient temperature or the temperature of the medium lies outside the permissible range, the sensor and the electrolyte may be damaged.

- Make sure that in all the operating phases the temperatures comply with the permissible values specified on the data sheet.
- The measuring value can be falsified if the temperature in the medium fluctuates abruptly.
- Make sure that the temperature in the water changes only slowly.

3.5.10 Impermissible installation position

If the sensor is not installed upright the measuring value can be falsified.

- Install the sensor upright.

3.5.11 Incorrect chemical analytical methods

Incorrect determination of the concentration of the disinfectant will lead to incorrect calibration of the sensor.

- Employ the recommended analytical methods as specified on the data sheet.
- Perform analytical work in accordance with the specifications in the manufacturer's operating instructions for the analytical equipment.

4 Commissioning

The sensor is supplied ready for operation, i.e. the sleeve is already filled with electrolyte.

4.1 Installation requirements

The following installation requirements must be satisfied:

- Continuous power supply and presence of water being measured
- Minimum through flow rate as specified on the data sheet
- Constant through flow rate
- There must be disinfectants present in the water being measured.
- There must be galvanic isolation at the electrical connections (if not already present in the sensor, see data sheet.
- The water being measured must not be evolving gas at the measurement point.

4.2 Preparation of the sensors

- Grasp the sensor by the sleeve, and unscrew the protective cap.
- The protective cap is filled with electrolyte.

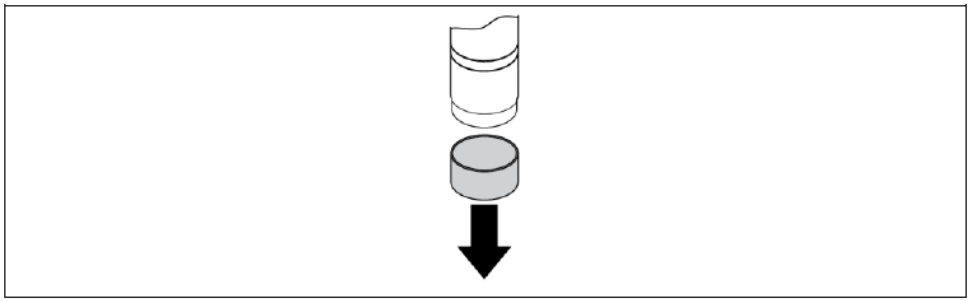


Fig. 3: Unscrewing the protective cap

If the sleeve was inadvertently loosened:

- Top up the electrolyte (see section 7.3).
- The sensor is now prepared for commissioning without the CEH-F3.

4.3 Fitting the cleaning head to the sensor

- The sensor must have been prepared for installation (see section 4.2).
- Check that the retaining ring, slide ring and O-ring 25 x 2.5 [1] are correctly positioned on the sensor.
- Unscrew the flow chamber.
- Take the O-ring retainer [2] off the flow cell
- Working from the electrodes end, slide the O-ring retainer with the recess for the O-ring 25 x 2.5 on to the sensor body.

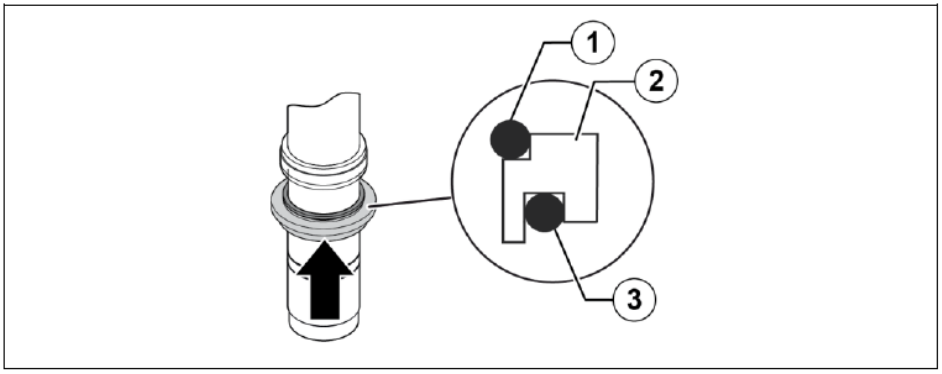
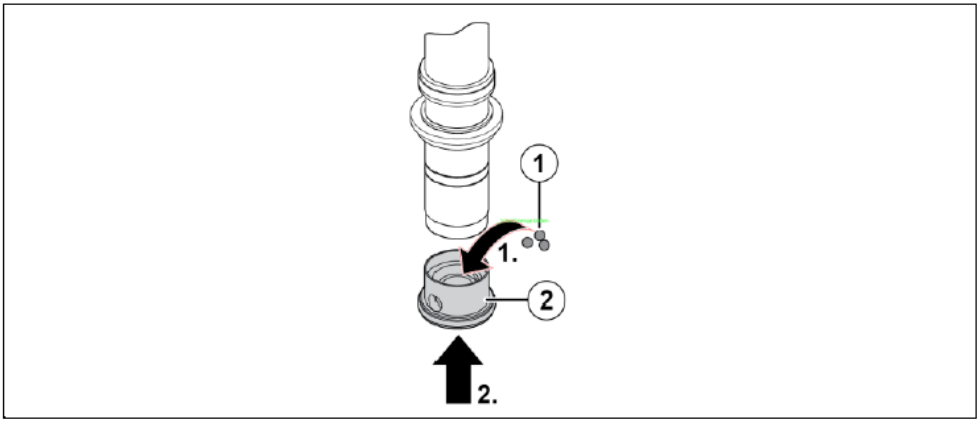


Fig. 4: Sliding the O-ring retainer on to the sensor body

1 O-ring 25 x 2.5
2 O-ring retainer
3 O-ring 30 x 2.6

Take 3 cleaning balls [1] out of the bag and place them in the CEH-F3.
The additional bag contains 3 spare cleaning balls.

- Screw the CEH-F3 on to the sleeve.



1 Cleaning balls
2 Cleaning head cap

- The sensor is now prepared for commissioning with the cleaning head cap.

4.4 Inserting the sensor into the flow chamber

- The sensor must have been prepared for installation (see section 4.2).
- In order to insert the sensor correctly into the flow chamber:
- Comply with the instructions in the operating instructions for the flow chamber or the flow chamber that is used.

For correct operation of the cleaning head it is essential that the flow chamber is used.
A flow rate of 45-90 l/h is necessary for correct operation of the cleaning head.

5 Calibration

The sensor outputs a signal proportional to the concentration of the disinfectant in the water being measured. In order to assign the value of the sensor signal to the concentration of the disinfectant in the water being measured, the sensor must be calibrated.

- The flow rate must be constant.
- The temperature of the water being measured must be constant.
- Acclimatization of the temperature of the sensor to that of the water being measured must be complete (this takes about 20 minutes after a change in temperature).
- The sensor must have completed running in.
- No other oxidant may be present in the water being measured.
- The pH value must be constant (applies only to chlorine).
- Take the analytical sample of the water being measured from near to the sensor.
- Using appropriate methods, determine the concentration of the disinfectant in the water being measured (see the manufacturer’s operating instructions for the analytical equipment).

- In the calibration menu of the measuring and control device, mark up the sensor signal against the value determined by the analytical procedure (see the operating instructions for the device).
- Repeat the calibration at regular intervals (see section 7.1).
- Comply with the applicable national regulations for calibration intervals.

Measured variables	Recommended analytical methods	
Free chlorine	DPD-1	Photometer for chlorine
Chlorine dioxide	DPD-1	Photometer for chlorine dioxide

Tab. 5: Recommended analytical methods

Chlorine dioxide can also be determined using a photometer intended for chlorine. The result must be multiplied by a factor of 1.9. At higher concentrations of disinfectant the DPD coloration may fail to appear.

7 Maintenance

7.1 Maintenance overview

To ensure optimum performance of the sensor:
Perform the following actions at regular intervals: Maintenance task Interval

- Clean the electrodes
  - Without CEH-F3
  - 4…12 weeks
  - With CEH-F3
  - 6…12 months
- Change the electrolyte
  - 3…6 months
- Change the cleaning balls
  - Annually
- Perform calibration
  - Weekly
  - After the electrolyte has been changed
  - After the cleaning balls have been changed
  - After the electrodes have been cleaned

7.2 Cleaning the electrodes

- Take out the sensor (see section 6).
- If a CEH-F3 is present:
  Grip the sleeve and unscrew the CEH-F3.
  Make sure that the cleaning balls don't escape.
  Use mains water to rinse the working electrolyte / counter electrode.
  Lay a piece of special emery paper on a paper wipe.

Hold the sensor upright.
Hold the special emery paper in position and move the electrodes across it at least twice. Use a fresh area of the special emery paper for each pass. Hold the sensor in such a way that both the electrodes are drawn across the special emery paper alongside each other.

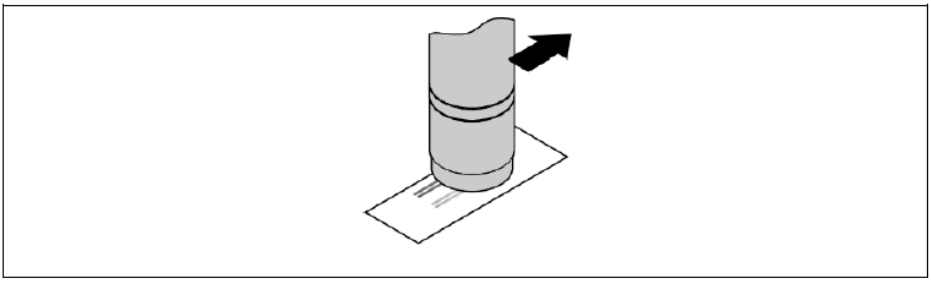


Fig. 9: Cleaning the electrodes

Perform the same operations as for commissioning (see section 4).

- Maintenance has now been completed and the sensor can be put back into use.

7.3 Changing the electrolyte

- Take out the sensor (see section 6).
- If an CEH-F3 is present:
  Grip the sleeve and unscrew the CEH-F3.
  Make sure that the cleaning balls don't escape.
  Unscrew the sleeve and use water to rinse it.
  Rinse the electrode finger with water.
- Only for F3 & D3
  Make sure that the reference cartridge [1] remains on the reference electrode.
  If it slips down: Carefully push the reference cartridge back on to the reference electrode.

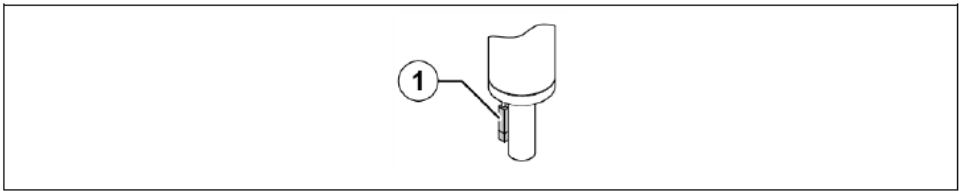


Fig. 10: Reference cartridge on the reference electrode

1 Reference cartridge

Screw the sleeve sufficiently far down the electrode finger that the spout of the bottle of electrolyte fits into the resulting gap (approx. 5 mm).

- Fill the sleeve with electrolyte, ensuring no bubbles are present.
- Fully screw on the sleeve.

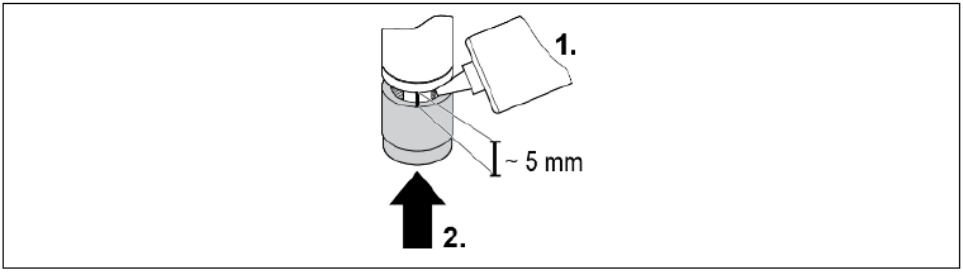


Fig. 11: Screwing the sleeve down the electrode finger and filling it with electrolyte

Use mains water to rinse off any electrolyte residues adhering to the sensor.

- Perform cleaning of the electrodes as a maintenance operation (see section 7.2).
- Perform the same operations as for commissioning (see section 4).
- Maintenance has now been completed and the sensor can be put back into use

7.4 Maintenance of the CEH-F3

Cleaning of the electrodes must have been performed (see section 7.2).
Before screwing the CEH-F3 on to the sensor:

- Insert 3 new cleaning balls into the CEH-F3.
- Maintenance of the CEH-F3 is now complete.
- Perform the same operations as for commissioning (see section 4.3).

8 Troubleshooting

Various factors in the environment can affect the sensor. If irregularities occur, it may be useful to check these factors:

- Flow rate
- Measuring cable
- Measuring and control device
- Calibration
- Dosing equipment
- Concentration of the disinfectant in the dosing container
- Suitability of the sensor for measuring the disinfectant that is being dosed
- Concentration of the disinfectant in the water being measured (determined by analytical methods)
- pH value of the water being measured
- Temperature of the water being measured
- Pressure in the flow chamber
- Analytical methods

Fault	Cause	Corrective Action
Sensor cannot be calibrated / deviation of the measured value from DPD measurement.	Run-in time to short	• Run-in time is 1 to 48 hours. • Repeat the calibration after a few hours
	Sample water flow and/or pressure too low	• Increase sample water flow and pressure (see section 4.1)
	The sleeve is damaged	• Change the sleeve
	Disruptive substances in the water contents	• Check the water for disruptive substances and remedies (see data sheet) • Consult the supplier
	Short circuit	• Locate and eliminate the short circuit / wiring defect
	The sleeve is not fully screwed on.	• Screw the sleeve on fully to the stop. • Perform maintenance on the sensor (see section 7)
	The DPD chemicals are past their expiration date.	• Use new DPD chemicals • Repeat calibration (see section 5)
	Deposit on the electrodes	• Clean the electrodes (see section 7.2)
	No electrolyte in the sleeve	• Fill the sleeve with electrolyte • Prepare the sensor (see section 4.2)
	The concentration of disinfectant exceeds the upper limit of the measuring range.	• Check the chemical feed system and remedy faults • Repeat the calibration (see section 5)
	The protective cap had not been removed before fitting the sensor	• Remove the sensor • Remove the protective cap (see section 4.2) • Commission the sensor (see section 4)
	Gas bubbles on the electrodes	• Increase flow rate • Check cleaning head (see section 4.3)
	Analytical methods: When operating under pressure,	• Repeat the analysis • Comply with the

	too many gas bubbles in the sample of water being measured.	manufacturer's operating instructions for the analytical equipment.
	Lack of galvanic isolation	• Replace the ground pin • Return the sensor to the supplier for checking / reconditioning.
	The sensor is defective	• Return the sensor to the supplier for checking / reconditioning.

Unstable measuring value	Sample water flow and/or pressure fluctuation	• Stabilize the sample water flow and pressure (see section 4.1)
	Sensor maintenance required	• See section 7
	Deposit on the electrodes	• Clean the electrodes (see section 7.2)
	Gas bubbles on the electrodes	• Increase the flow rate. • Check cleaning head (see section 4.3)
	Lack of galvanic isolation	• Replace the ground pin • Return the sensor to the supplier for checking / reconditioning
	The reference electrode is exhausted and/or contaminated.	• Return the sensor to the supplier for checking / reconditioning
	Excessive concentration of disinfectant in the water being measured	• Check the chemical feed system and remedy faults • Repeat the calibration (see section 5) • Perform maintenance on the sensor (see section 7)
Overdriving	Run-in time too short	• Run-in time is 1 to 48 hours. • Repeat the calibration after a few hours
	Flow rate too high	• Check the system • Reduce the flow rate
	Lack of galvanic isolation	• Replace the ground pin • Return the sensor to the supplier for checking / reconditioning

	The sensor is defective	• Return the sensor to the supplier for checking / reconditioning

Under-driving	Run-in time too short	• Run-in time is 1 to 48 hours. • Repeat the calibration after a few hours
	Sample water flow and/or pressure too low	• Increase sample water flow and pressure (see section 4.1)
	Sensor maintenance required	• See section 7
	Lack of galvanic isolation	• Replace the ground pin • Return the sensor to the supplier for checking / reconditioning
	The sensor is defective	• Return the sensor to the supplier for checking / reconditioning
No Signal	Short circuit / the sensor is not receiving any power	• Locate and eliminate the short circuit / wiring defect
	No electrolyte in the sleeve	• Fill the sleeve with electrolyte • Prepare the sensor (see section 4.2)
	The sensor is defective.	• Return the sensor to the supplier for checking / reconditioning

8.2 Special Checks

8.2.1 Electronics

If a CEH-F3 is present:

- Grip the sleeve and unscrew the CEH-F3.
- Rinse the working electrode / counter electrode with mains water.
- Using a clean cloth, carefully dry the working electrode / counter electrode.
- Connect the sensor to the measuring and control device.
- Connect a suitable measuring device to the original sensor signal.
- Wait five minutes.
- Read the original sensor signal at the measuring device.
- Mark up the values that were read against the following target values:
- Sensor (mV): approx. +/- 0 mV
- Sensor (mA): approx. 4 mA
- Sensor (Modbus): approx. 0 ppm or 0%
- If the sensor signal corresponds roughly with the above value, the electronics can provisionally be regarded as OK.
- If the measured value deviates significantly from the above value:
- Return the sensor to the supplier for checking.

8.2.2 Checking the zero point

- The electronics must have been tested and found to be OK.
- Connect the sensor to the measuring and control device.
- Fill a glass beaker with mains water (without any disinfectant!).
- Stir the sensor round in the glass beaker for 30 seconds.
- Carefully put the sensor down obliquely in the glass beaker.
- Wait 30 minutes.
- Read the measuring value.

If the measuring value is close to the value 0, the zero point can provisionally be regarded as OK.

If the measuring value deviates significantly from zero:

- Perform maintenance on the sensor (see section 7) and repeat the zero point test.

A freshly cleaned working electrode has a relatively high zero point. The sensor takes a few days to settle back to its lowest zero point.

If after maintenance has been performed on the sensor measuring value is not close to zero:

- Return the sensor to the supplier for checking.
- This completes the zero point checking.

8.2.3 Signal

- The zero point checking must have been performed successfully.
- Add the relevant disinfectant to the mains water in the glass beaker (see section 8.2.2).
- Stir the sensor steadily round in the glass beaker for five minutes.
- Monitor the measuring value throughout this time.

If the measuring value increases, the sensor can provisionally be regarded as OK.

If the measuring value does not change:

- Perform maintenance on the sensor (see section 7) and repeat the signal test.

- This completes the signal test. The sensor can be put back into use.

If after maintenance the sensor shows no response to the disinfectant:

- Return the sensor to Hydro Instruments for checking.

9 Technical data

Information on the technical data can be found at the following Internet address:
http://www.hydroinstruments.com

10 Removal and storage

To remove a sensor and prepare it for storage, proceed as follows:

10.1 Wet storage

- Perform a change of electrolyte as a maintenance operation (see section 7.3).
- Fill the protective cap with electrolyte.
- Screw the filled protective cap on to the sensor.
- Use mains water to rinse off any electrolyte residues adhering to the sleeve, and dry it with a clean cloth.
- The sensor can be stored for up to a year in a dry dust-free place.

10.2 Dry storage

- Unscrew the sleeve.
- Use mains water to rinse the sleeve.
- Rinse the electrode finger with mains water.
- Use mains water to rinse the protective cap.
- Dry the sleeve, sensor body and protective cap in a dust-free place.
- Screw the sleeve on to the sensor body.
- Screw the protective cap on to the sleeve.