Free and Total Chlorine Sensors NCL and NCT model

PLEASE READ CAREFULLY THE FOLLOWING INSTRUCTIONS FOR USE.
DO NOT THROW THEM AWAY.
THE SYSTEM MANAGER WILL BE RESPONSIBLE FOR ANY DAMAGE CAUSED BY INSTALLATION OR MANAGEMENT ERRORS.

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1 INTRODUCTION

This assembly and use manual describes the technical data and functions of the sensors of the NCL and NCT range, for the measurement of Free Chlorine and Total Chlorine.
The characteristics of the different sensors are shown in Table 1 below, where it is indicated which is the measured analyte, the measurement range, the resolution and the type of electrical output, for the different sensors, to which this manual can be applied.
The range of sensors for the measurement of free and total chlorine has a structure of the type with three electrodes, two of which are covered by a membrane cap and immersed in a gel electrolytic solution. The range allows to measure the concentration of free/total chlorine in surfactant-free water.
These devices can be used in all those situations where the following operations are required:

- Control and regulation of swimming pool chlorination.
- Control and regulation of the chlorination of drinking water.

Tab 1: Characteristics of the different sensors to which this manual is applicable

Name	Analyte	Measurement range [ppm]	Resolution[ppm]	Output
NCL T20	Free Chlorine	0.05 ÷ 20.00	0.01	0 ÷ -2000 mV
NCL T10	Free Chlorine	0.05 ÷ 10.00	0.01	0 ÷ -2000 mV
NCL T5	Free Chlorine	0.05 ÷ 5.00	0.01	0 ÷ -2000 mV
NCL T2	Free Chlorine	0.01 ÷ 2.00	0.005	0 ÷ -2000 mV
NCL C20	Free Chlorine	0.05 ÷ 20.00	0.01	4 ÷ 20 mA
NCL C10	Free Chlorine	0.05 ÷ 10.00	0.01	4 ÷ 20 mA
NCL C5	Free Chlorine	0.05 ÷ 5.00	0.01	4 ÷ 20 mA
NCL C2	Free Chlorine	0.01 ÷ 2.00	0.01	4 ÷ 20 mA
NCT T20	Total Chlorine	0.05 ÷ 20.00	0.01	0 ÷ -2000 mV
NCT T10	Total Chlorine	0.05 ÷ 10.00	0.01	0 ÷ -2000 mV
NCT T5	Total Chlorine	0.05 ÷ 5.00	0.01	0 ÷ -2000 mV
NCT T2	Total Chlorine	0.01 ÷ 2.00	0.005	0 ÷ -2000 mV
NCT C20	Total Chlorine	0.05 ÷ 20.00	0.01	4 ÷ 20 mA
NCT C10	Total Chlorine	0.05 ÷ 10.00	0.01	4 ÷ 20 mA
NCT C5	Total Chlorine	0.05 ÷ 5.00	0.01	4 ÷ 20 mA
NCT C2	Total Chlorine	0.01 ÷ 2.00	0.01	4 ÷ 20 mA
NCL T20 SW	Free Chlorine	0.05 ÷ 20.00	0.01	0 ÷ -2000 mV
NCL T10 SW	Free Chlorine	0.05 ÷ 10.00	0.01	0 ÷ -2000 mV
NCL T5 SW	Free Chlorine	0.05 ÷ 5.00	0.01	0 ÷ -2000 mV
NCL T2 SW	Free Chlorine	0.01 ÷ 2.00	0.005	0 ÷ -2000 mV
NCL C20 SW	Free Chlorine	0.05 ÷ 20.00	0.01	4 ÷ 20 mA
NCL C10 SW	Free Chlorine	0.05 ÷ 10.00	0.01	4 ÷ 20 mA
NCL C5 SW	Free Chlorine	0.05 ÷ 5.00	0.01	4 ÷ 20 mA
NCL C2 SW	Free Chlorine	0.01 ÷ 2.00	0.01	4 ÷ 20 mA

1.1 MATERIALS CONTAINED IN THE SET

The device is supplied in its packaging and is presented as shown in Figure 1 and in Figure 2, in which the standard kit consists of:

I. sensor;
II. upper element (not present in the version with voltage output);
III. membrane cap;
IV. bottle of gel electrolyte (100ml);
V. paper for polishing the gold electrode;
VI. user manual

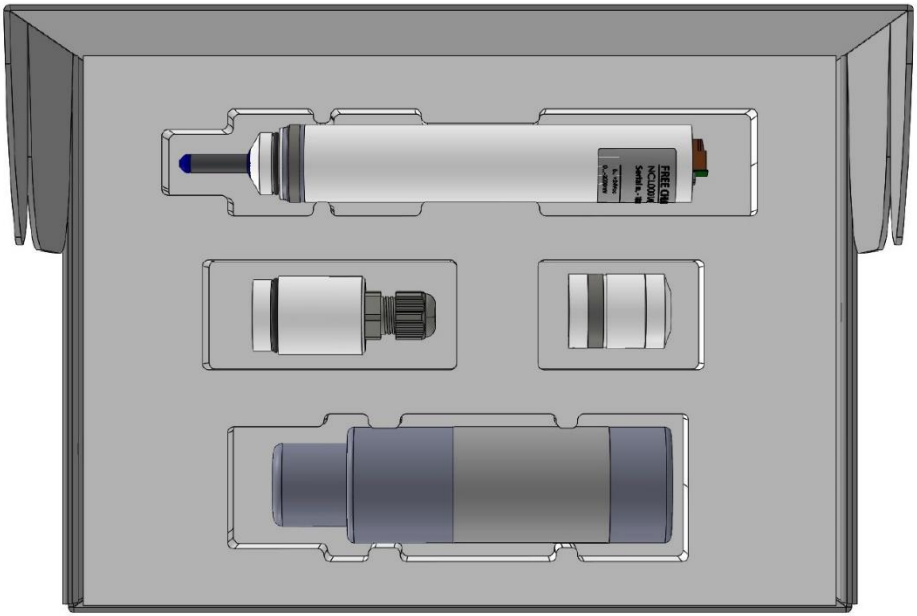


Figure 1: version with current output standard supply

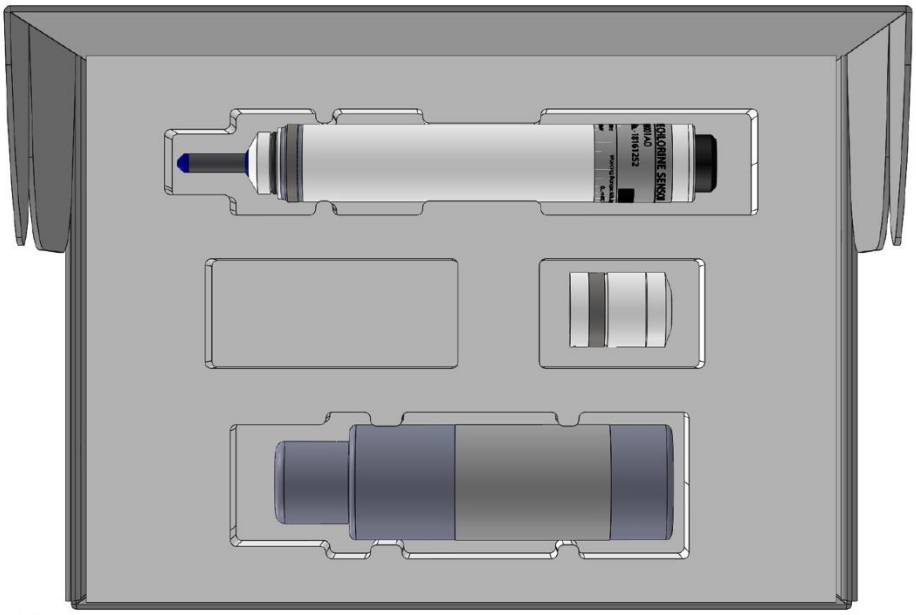
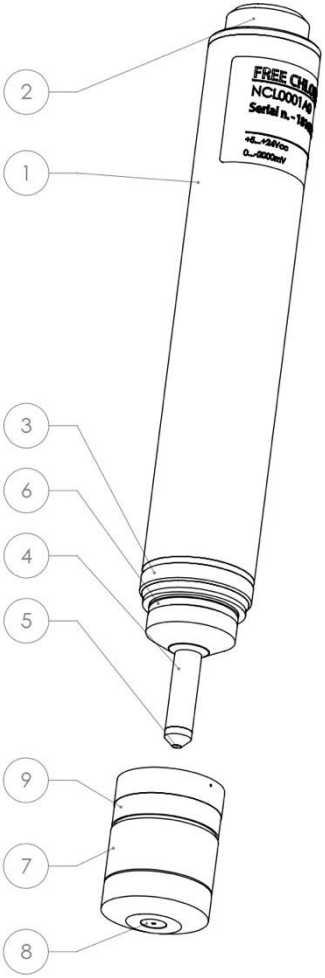


Figure 2: version with voltage output standard supply

1.2 STRUCTURE OF THE SENSOR

The parts composing the sensor are shown in Figure 3.



Position	Description
1	Sensor body
2	Connector
3	Counter electrode
4	Reference Electrode
5	Working electrode
6	O-Ring
7	Cap
8	Membrane
9	Tubular gasket

Figure 3: Sensor structure and description of its components.

2 INSTALLATION

2.1 ASSEMBLY/DISASSEMBLY OF THE CAP

Before proceeding with the assembly/disassembly operation of the cap from the probe body, the tubular gasket must be moved from its position on the cap. Pay attention that the vent hole, highlighted in Figure 4 and the other holes present, remain uncovered throughout the assembly phase.

WARNING!

By leaving the tubular gasket in its place, during the operations of disassembly and assembly of the cap from the probe, you risk damaging the membrane, compromising the functioning of the probe. Also be careful not to cover the upper holes with your fingers during the assembly or disassembly phase.

2.2 FILLING THE CAP WITH ELECTROLYTIC SOLUTION

Fill the cap with the gel electrolyte solution contained in the bottle present in the package. The gel electrolyte must reach the edge of the cap, as reported in Figure 4, leaving the tubular gasket displaced from its place.
Insert the probe vertically into the cap as shown in Figure 5 on the next page, taking care during the assembly phase not to cover the excess gel outlet holes with your fingers. This is in order not to damage the membrane and to avoid the formation of air bubbles in the solution once the cap is tightened. By almost completely screwing the cap to the probe, you will feel a slight resistance due to the presence of the O-ring which guarantees the seal of the coupling.

Once the cap has reached the mechanic stop with the probe and the excess gel has been expelled from the holes, the tubular gasket must be repositioned in its place in order to avoid gel leaks during the normal use of the probe in flow.

Figure 4: Cap filling phase with gel electrolyte.

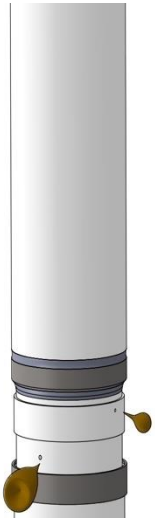


Figure 5: Assembly phase of the cap on the probe.

SLOWLY SCREW THE PROBE CAP.

To ensure the correct functioning of the probe, it is necessary to avoid that the air bubbles remain trapped inside the gel solution in the cap. For this reason, it is useful to slowly screw the cap to the probe, and not to shake the bottle before use.

After filling or restoring the electrolyte solution, the probe takes about an hour to resume normal operation.

RESTORING THE ELECTROLYTIC SOLUTION

It is recommended to calibrate the instrument to which the probe is connected after the operation has been restored. It is recommended to repeat the calibration procedure after 24 h.

DO NOT TOUCH THE CAP AND ELECTRODES

Do not touch the membrane on the cap, nor the electrodes placed in the lower part of the sensor; do not damage them and avoid that they come into contact with greasy substances. Otherwise, the sensor will no longer function accurately. In this case, replace the cap with a new one or send the sensor to the manufacturer for cleaning the electrodes.

WARNING!

During all assembly, maintenance or other operations it is recommended not to touch the membrane, in order to avoid damage that could lead to malfunction of the probe.

2.3 INFORMATION ON THE ELECTROLYTE GEL

KEEP THE PRODUCT OUT OF REACH OF CHILDREN!

ELECTROLYTE GEL.

DO NOT SHAKE THE BOTTLE BEFORE USE!

- ✓ The electrolyte is sensitive to oxidation: always keep the bottle of electrolyte closed after use.
- ✓ Do not transfer the electrolyte into other containers.
- ✓ The electrolyte must not be stored beyond the permitted terms; for the expiry date see the label on the electrolyte bottle.
- ✓ Pour in the electrolyte avoiding, where possible, the formation of bubbles. The small air bubbles are not a problem, while the larger bubbles rise towards the upper edge of the cap and affect the measurement.
- ✓ Store the gel electrolyte bottle with the cap facing down, as indicated on the bottle label.

WARNING! RISK DUE TO A DANGEROUS SUBSTANCE.

When using hazardous substances, please note that updated safety data sheets of the manufacturers of these substances are available. Since the risk potential of a substance can be re-evaluated at any time based on new knowledge, the safety data sheet must be checked regularly and replaced if necessary.

The system operator is responsible for the availability of the updated version of the safety data sheet and for the preparation of the risk assessment of the workplaces concerned connected to it.
The information relating to the gel electrolyte and the safety data sheet are available on the manufacturer's website at http://www.aedes.info/prodotto.asp

2.4 MOUNTING ON THE PROBE HOLDER

Insert the probe into a dedicated probe holder in the appropriate housing. A distance of about 2 cm must be ensured between the membrane and the bottom of the probe holder as indicated in Figure 6 on the next page, in order to ensure optimal operation of the probe.

The phase of installing the probe in the probe holder must be carried out delicately; do not push too hard to avoid the risk of damaging the membrane due to excessive pressure. In order to avoid the occurrence of an overpressure it is recommended to open at least one drain valve or sampling cock. Once the probe is blocked in the probe holder at the desired height, it is possible to close the drain valve or sampling cock, and gradually open the delivery cock.

INSTALLATION INSTRUCTION

- ✓ Make sure that the membrane does not come into contact with other objects to avoid damage and obstruction of the membrane.
- ✓ Once the probe has been positioned on the probe holder, it is recommended to slowly open the delivery cock to protect the membrane from the pressure front produced by the water flow.
- ✓ After installation, the sensor must always be kept wet, e.g. the probe holder must never run dry.

2.5 FLOW ADJUSTMENT

To ensure correct operation of the probe, the flow rate of fluid passing through the probe holder must be between 30 l/h and 60 l/h and with a pressure between 0 bar and 1 bar (the recommended working range for probe is 0.3 - 0.5 bar).

WATER FLOW

Do not exceed the recommended working range:

- ✓ do not use the sensor with a lower or higher range than the indicated limits;
- ✓ before commissioning the probe, the flow rate must be measured using suitable measurement methods.

INSTALLATION INSTRUCTIONS

Avoid installations that create air bubbles in the sample water. The air bubbles adhering to the sensor membrane can cause an insufficient measurement value. An insufficient measured value can lead to incorrect dosing in a control circuit.

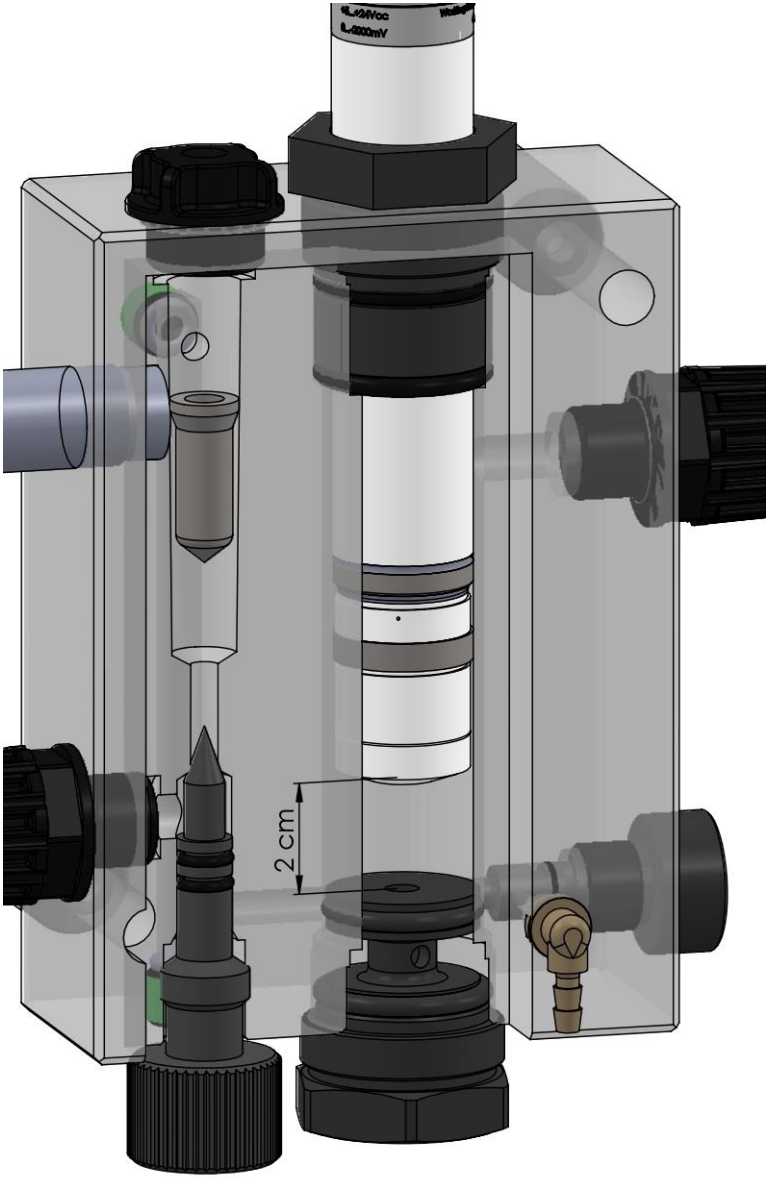


Figure 6: installation of the probe in a probe holder, where the optimal operating distance is shown

3 ELECTRICAL CONNECTIONS

3.1 ELECTRICAL INSTALLATION OF VOLTAGE OUTPUT

The probe equipped with the electric voltage output (0 ÷ −2000 mV) is provided with a circular connector. It is essential, to connect the probe to the measuring instrument, to use the dedicated electric cable (see paragraph 5.1 page 21 to identify the code) to be purchased separately. The cable is made up on one side of the connector and on the other of the wires as in Figure 7, to be connected as shown in Table 2. For the electrical installation of the probe, it is necessary to connect the cable to the measuring instrument and then couple the connector on the cable to the connector on the probe.

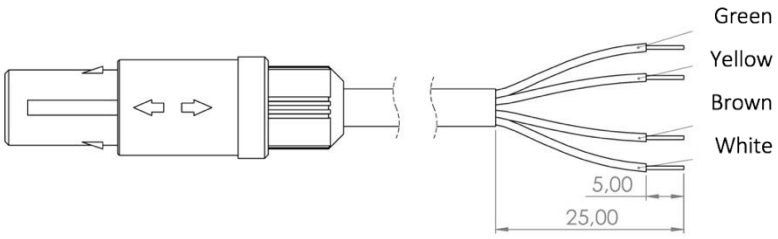


Figure 7: Electrical connection of cables to the measuring instrument

Table 2: Characteristics of electrical connections

Terminal	Color	Function	Value
1	Green	Signal (V_{out})	0 ÷ -2000 mVdc
2	Yellow	Signal (GND)	0
3	Brown	Power supply (+V_{in})	+10 ÷ +30 Vdc
4	White	Power supply (GND)	0

Single Power Supply

Terminal	Color	Function	Value
1	Green	Signal (V_{out})	0 ÷ -2000 mVdc
2	Yellow	Signal (GND)	0
3	Brown	Power supply (+V_{in})	+5 ÷ +15 Vdc
4	White	Power supply (-V_{in})	-5 ÷ -15 Vdc

Single Power Supply

3.2 ELECTRICAL INSTALLATION OF CURRENT OUTPUT

Below is reported the procedure for the electrical installation of the probes equipped with the current output with two-wire connection, as shown in Figure 8

1. Rotate the upper element (3) of the sensor counterclockwise and extract the upper element.
2. Loosen the locking nut (2) of the threaded connector and pass the measuring cable (1) through it.
3. Uncover the ends of the cable by 0.5 cm, apply the cable lugs (ϕmax =0.5 mm2) and connect them to the 2-conductor connection respecting the polarity indicated on the terminal (4).
4. Fully insert the upper element of the sensor (3) on the probe body (5) and tighten it by turning clockwise until it stops.
5. Insert the measurement cable as far as possible into the upper element of the strain relief sensor.
6. Tighten the lock nut (2) on the threaded connector.

Terminal	Function	Value
+	Power supply (+V_{in})	+12 ÷ 30 Vdc
-	Power supply (GND)	0

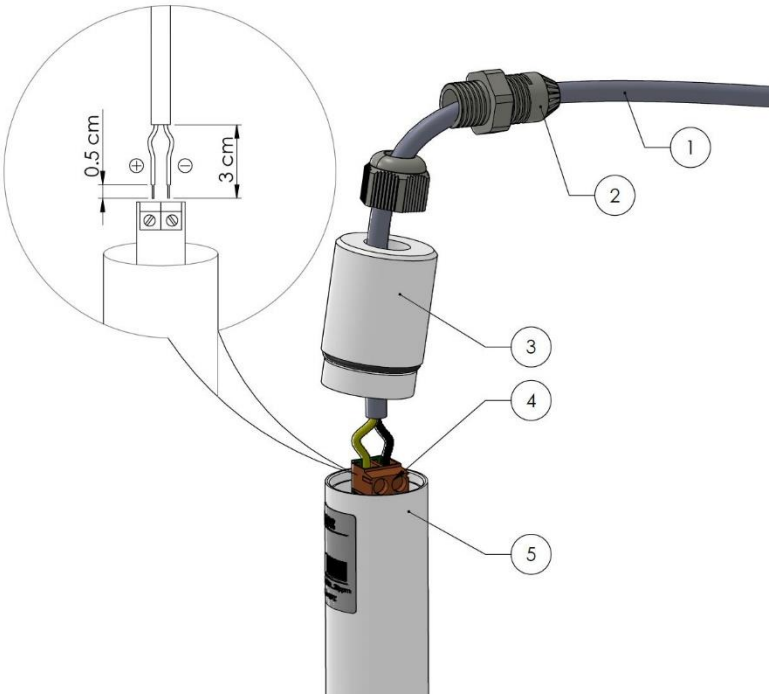


Figure 8: Electrical installation for probes with two-wire current output

4 ACTIVATION AND MAINTENANCE OF THE SENSOR

4.1 SENSOR COMMISSIONING

Once the sensor has been mounted on the probe holder and checked the correct working conditions, such as the probe insertion height, the control water flow rate and the pressure, and the connection to the electrical measuring system has been made, the activation times of the probe are those shown in Table 3. In any case, the activation times depend on the working conditions of the system where the sensor is placed.

Table 3: Activation times required for the probe to provide a stable signal

Phase	Time [h]
First Installation	1 ÷ 24
Subsequent installations	1 ÷ 24
Gel and/or Cap replacement	1 ÷ 3

4.2 CALIBRATION

PROBE CALIBRATION

Depending on the accuracy required of the probe, it may be necessary to calibrate once a week. It may be necessary to carry out calibration whenever the working conditions of the water are changed (analyte concentration, temperature or pressure), or after replacing the gel electrolyte and/or membrane.

The probe calibration must be carried out once the probe signal is stable, therefore not before the activation times indicated in Table 3.
The calibration of the measuring instrument connected to the probe must be carried out and checked periodically using the DPD-1 method ("Free Chlorine").

The frequency of checks depends on the installation requirements and working conditions.

Calibration allows you to align the value obtained with the DPD-1 method with the measured value of the probe, depending on the characteristics of the controlled water

pH VALUE

The calibration of the probe and instrument set must be carried out at a pH value within the working range of the probe in question

The correct procedure for calibrating the instrument connected to the probe is as follows:

1. Take a sample of water from the sampling cock making sure to let it flow for a few seconds before taking it, to avoid erroneous measurements;
2. carry out the operations described in the manual of the instrument used to carry out the DPD-1 measurement;
3. enter the ppm value obtained with the DPD-1 measurement in the measuring instrument to which the probe is connected, respecting the procedure provided in the instrument manual.

If it is necessary to carry out the zero calibration of the instrument:

1. Remove the sensor from the probe holder, taking care not to disconnect it from the power supply.
2. Place the sensor in a container containing clean water, free of chlorine and oxidants (e.g. natural mineral water without gas).
3. Mix the water in the container with the probe continuously immersed in water, and after a certain period of time change the water in the container, mix again and then leave the sensor to rest in the container with the water.
4. Carry out the operation several times according to the chlorine content in the system (if it was not a first installation calibration). Wait for the signal to remain stable.
5. Calibrate the instrument to which the probe is connected to zero by following the instructions given in the user manual of the same.
6. Re-mount the sensor on the probe holder and turn the flow back on.

4.3 Electrode Unit and Cap Maintenance

If the values measured by the probe are abnormal (or excessively low, to the point of not allowing correct calibration or excessively high), the probe must be removed from the system and the following operations must be performed:

- Cap cleaning
- Cleaning of the working electrode.

Maintenance Information

To ensure correct operation of the probe, it is recommended to restore the gel approximately every 3 - 6 months, and replace the membrane cap every 6 - 12 months, depending on the quality of the water analyzed. The frequency of maintenance is linked to the operating conditions of the water in which the probe operates.

If sediment is found on the membrane, it is recommended to clean it by washing the cap under a gentle jet of warm water. In the event that this operation does not lead to improvements, please contact the assistance center.

If the presence of oxides or residues is observed on the working electrode, as in Figure 9, it is recommended to clean it using the special paper in the package. The paper has a shiny and a matte side; the matte side is the one to be used on the working electrode as shown in Figure 10.
In the event that this operation does not lead to improvements, please contact the assistance center. Do not use the paper on the membrane or other parts

Use of Abrasive Paper

Use the abrasive paper **only and exclusively** on the working electrode. Improper use of the papers on the other electrodes or on the membrane compromise the functioning of the probe.

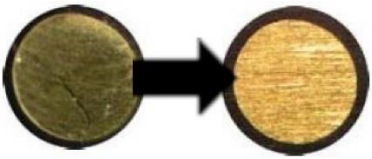


Figure 9: Working electrode before and after cleaning

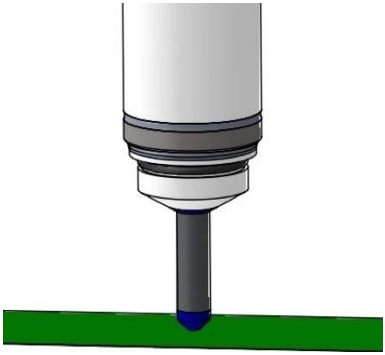


Figure 10: Cleaning the working electrode with abrasive paper

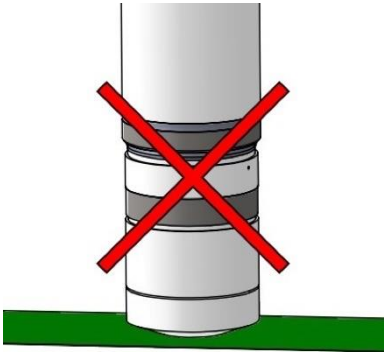


Figure 11: Do not use abrasive paper on the membrane

4.4 PUT THE PROBE OUT OF SERVICE

To ensure that the probe functions properly after a long period of inactivity, the following procedure must be strictly followed:

1) Disconnect the sensor from any electrical connection.
2) Depressurize the probe holder.
3) Loosen the tightening nut of the probe holder.
4) Slowly extract the sensor from the probe holder.
5) Unscrew and remove the cap.
6) Rinse the electrodes with a jet of warm water, leaving no residue. **Do not touch the electrodes with your fingers**.
7) Leave the cap and the probe to dry, in a place protected from dust. Do not use air jets.
8) To protect the electrodes during storage, screw the cap to the probe without tightening.
9) To protect the sensor, keep it in its specific box.

INSTALLATION INSTRUCTIONS

Before reactivating a probe that has been taken out of service for a long time, it is recommended to replace the cap with a new one.

INSTALLATION INSTRUCTIONS

Observe the regulations and legal dispositions currently in force for disposal.

INSTALLATION INSTRUCTIONS

TECNOSENS s.r.l. takes delivery only of sensors suitably separated from contaminating chemical elements to proceed with disposal.

4.5 Working Parameters and Sensor Characteristics

- ✓ Correspondence of output signal in voltage depending on the full scale: for example the probe with full scale at 20 ppm, the signal delivered will be −2000 mV therefore the correspondence will be equal to −100 mV for each ppm.
- ✓ Correspondence of output signal in current dependent on the full scale: for example the probe with full scale at 20 ppm will correspond to about 0.8 mA per ppm.
- ✓ All connections are protected against polarity inversion.
- ✓ The water pressure to which the probe is exposed must not exceed 1 bar.
- ✓ During operation, there must be no air bubbles near the membrane that could decrease, or even cancel, the measurement of the probe.
- ✓ The flow rate inside the probe holder must be stable and within the range of 30 ÷ 60 l h.
- ✓ The operating temperature must not exceed 45 °C. If the water temperature is close to 0 ◦C, it is essential for the operation of the probe that there are no ice crystals in the flow.
- ✓ The value measured by the sensor is not very dependent on the pH. The pH range, optimal for operation, is between 4 pH and 10 pH.
- ✓ The reference electrode can only be cleaned with water and left to dry on its own without the aid of cloths or paper. Sandpaper or other material should not be used on the reference electrode. Touching the reference electrode could compromise the correct functioning of the probe.
- ✓ A complete check of the probe is recommended every 5 ÷ 6 months. This term depends on the quality of the water and the outflow conditions.
- ✓ Always avoid sedimentation on the membrane. In this case, immerse the membrane in a 1% hydrochloric acid solution for a few minutes and then rinse carefully.
- ✓ The tubular gasket guarantees perfect insulation between the inside and outside of the membrane cap. If this seal is no longer ensured by the same, it is recommended to replace it with a new one.

5 TROUBLESHOOTING AND SPARE PARTS

5.1 SPARE PARTS

Code	Description
NAS0003A2	Cap for probes NCL
NAS0006A0	Cap for probes NCT
NSH0001A1	Gel electrolyte bottle (100ml) for NCL
NSH0002A0	Gel electrolyte bottle (100ml) for NCT
NAS0005A1	2 m cable for probes with voltage output

5.2 TROUBLESHOOTING

For troubleshooting, it is necessary to consider the entire measuring station. The measuring station consists of:

- Measurement and control instrument
- Power line and electrical connections
- Hydraulic line and related fittings
- Sensor

Before starting the troubleshooting, make sure that the operating conditions below are met.

If the measured values of the sensor deviate significantly from the measured value of the DPD method, all possible errors of the photometric DPD method must first be considered. If necessary, repeat the DPD measurement several times.

Table 4: Sensor operating condition summary

Parameter	Value
Concentration of chlorine	Dependent on the full scale of the probe
pH	4.0 ÷ 10.0, Constant
Temperature	0 °C ÷ 45 °C, without temperature changes
Conductivity	0.1 ÷ 63 mS / cm
Flow rate	30 ÷ 60 l/h

The following table shows the possible causes and solutions of the most common problems encountered on installations and during maintenance operations on the probes.

Problem detected	Possible cause	Solution
Weak signal No signal from the probe	Connection cable faulty	Replace the cable. See spare parts
	Connection cable incorrectly connected	Check that all connectors are properly secured. Check that the cables are connected with the right polarity.
	Damaged membrane (deformed, broken, dirty, etc.)	Replace the damaged membrane cap and restore the gel electrolyte. See spare parts.
	Dirty or oxidized working electrode	Remove oxidation with abrasive paper.
	Dirty or worn reference electrode	Rinse carefully using only water and allow to air dry without the use of cloths or anything else that would lead to damage to the chemical coating. If the reference electrode coating is damaged, contact assistance to carry out the regeneration.
	Contaminated or depleted gel electrolyte	Replace the gel in the cap with the one supplied if it is exhausted, see spare parts. Check the integrity of the reference electrode.
	Presence of air bubbles on the membrane	Replace the gel in the cap with the one supplied if it is exhausted, see spare parts. Check the integrity of the reference electrode.
	Incorrect calibration of the instrument where the probe is connected	Check the working conditions of the probe.
	Expired electrolyte gel	Check the expiration date on the package. See spare parts.
Unstable measurement signal	Irregular water flow in the probe holder	Check the outflow conditions upstream of the probe holder. Try to regulate the flow by closing the valve downstream of the probe holder respecting the flow range.
	Defective connection cable	Cable replacement. See spare parts.
	Presence of air bubbles inside the cap	Eliminate the air bubbles in the gel, add or replace the gel electrolyte if necessary, and screw the cap back on.
	Currents dispersed in the water	Check the correct grounding of the system. Check that there are no sources of electromagnetic fields near the probe.

Problem detected	Possible cause	Solution
Deformed or broken membrane	Extraction or insertion of the probe inside the probe holder without having opened the bleed valve	Membrane cap replacement. See spare parts
	Incorrect assembly or disassembly of the cap	Membrane cap replacement. See spare parts
	Operating pressure greater than 1 bar	Install a pressure regulator upstream of the probe holder or move the sampling point to a system position where the pressures are compatible with the operating conditions of the probe.
	Presence of solid abrasive particles in the water flow	Install a filter upstream of the probe holder to prevent particles from coming into contact with the probe. Membrane cap replacement. See spare parts
Presence of bubbles on the membrane surface	Flow rate and pressure of the sample water outside the operating range (30 ÷ 60 l/h and 0.3 ÷ 0.5 bar)	If the pressures are greater than those indicated, insert a valve to adjust the pressure upstream of the probe holder. Replace the membrane cap. See spare parts. If the pressures are lower than those required, try to throttle the system with a valve downstream of the probe holder.
Measurement deviation from the DPD value	Probe installed for too short a time.	Wait another time, repeat the calibration after a few hours.
	Damaged membrane (deformed, broken, dirty, etc.)	Replace the damaged membrane cap and restore the gel electrolyte. See spare parts.
	Presence of chemicals that can interfere with the measurement	Evaluate the presence of interferents present in the measurement water and remove them. If necessary, contact the supplier.
	Reference electrode touched with the fingers before fitting the cap with the gel electrolyte.	Return the probe to the supplier for regeneration
Contaminated or depleted gel electrolyte	Tubular gasket deformed to the point of no longer guaranteeing the tightest seal on the cap holes.	Replace the tubular gasket. See spare parts.

Problem detected	Possible cause	Solution
	Incorrectly screwed cap, which caused water infiltration and/or leakage of gel electrolyte.	Clean the working electrode and replace the electrolyte gel. Carefully screw the cap back on and reposition the tubular gasket correctly. It may be necessary to re-calibrate the instrument to which the probe is connected.

6 DIRECTIVES AND STANDARDS OBSERVED

Reference EC directives:

- EMC Directive (2014/30 / EU)
- ROHS Directive (2011/65 / EU)

International standards:

- EN 61010-1
- EN 60335-1
- EN 60529
- EN 61326-1

NOTICE

We reserve the right to make changes at any time and without notice in colors, materials, specifications and designs.

7 NOTES

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