



**STEIEL**  
ELETTRONICA SRL

# **CAC – CHLORINE Series**

## **Closed Amperometric Cells**

### **for continuous analysis of chlorine**

**TECHNICAL MANUAL**



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**Certified Company, according to UNI EN ISO 9001 standards**

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## WARNINGS



This manual is dedicated to the technical personnel responsible of the installation, management and maintenance of the plants. The manufacturer assumes no responsibility for damages or malfunctions occurring after intervention by non-authorized personnel, or not compliant with the prescribed instructions.



Before performing any maintenance or repair action, ensure that the system is electrically and hydraulically insulated.



Dispose of waste material and consumables accordingly with local regulations.

## How to ship the cell

To send back the cell for repairing or calibration purposes, proceed as follows:

- Fill the module “REPAIR REQUEST AND DECONTAMINATION DECLARATION” supplied with this manual, and include it in the transport documentation.
- Clean the cell properly, to eliminate any hazardous residuals.

**The manufacturer can modify the instrument or the technical manual without advanced notice.**

## Warranty

All STEIEL products are warranted for a period of 12 months from the delivery date.

Warranty is not valid if all installation, maintenance and working instructions are not followed as described in this manual, and prescribed by the applicable regulations.

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## PACKING LIST

1. Measurement cell with clamping ring, membrane-cap and protection cap
2. Specific electrolyte, 50 or 100 ml bottle (depending on model)
3. Technical manual

## INTRODUCTION

The CAC cells for the determination of chlorine in water, are sensors which ensure an efficient process control, thanks to accurate amperometric measurements with a short response time.

These cells have been designed to have a stable zero point and are equipped with a built-in temperature sensor, for thermo-compensation of readings.

Thanks to the membrane that covers the electrodes, the measurements are not affected by flow rate changes. Moreover, the electrolyte in which the electrodes are immersed helps to prolong the working life of the cell, creating a stable and protected measurement environment.

Models are available for the analysis of active free (inorganic), available (organic) and total chlorine, with measurement ranges from potable water up to wastewater.

The CAC-CLI-SW model is suitable to chlorine analysis in seawater, but not in presence of isocyanurate.

Cell	Range (mg/l)	Measurement	pH Range
CAC-CLI-XB	0.01 ... 0.5	Free chlorine (inorganic)	5.0 ... 9.5
CAC-CLI-B	0.02 ... 2.0		
CAC-CLI-SW	0.10 ... 10.0		
CAC-CLI-M1	0.20 ... 20.0		5.5 ... 8.0
CAC-CLI-M2	0.50 ... 50.0		
CAC-CLI-A1	1.00 ... 100.0		
CAC-CLI-A2	10.0 ... 200		
CAC-CLO-B	0.02 ... 2.0	Available chlorine (organic)	5.0 ... 9.5
CAC-CLO-M1	0.10 ... 10.0		
CAC-CLO-M2	0.20 ... 20.0		
CAC-CTO-XB	0.01 ... 0.5	Total chlorine	5.5 ... 9.5
CAC-CTO-B	0.02 ... 2.0		
CAC-CTO-M1	0.05 ... 5.0		
CAC-CTO-M2	0.10 ... 10.0		



## HEALTH AND SAFETY

### **General Information on Health and Safety:**

- The installation, use and maintenance of the cell must be performed by qualified technicians.
- The electrolytes used are chemicals: read the warnings on the electrolyte bottle before handling it.

### **Correct Use:**

- Install the cell in a special down-flow probe-holder (SD-CP series) equipped with flow sensor, by paying attention to not exceed the maximum working pressure of each part.
- The cell and connected measurement instrument must work continuously: after the initialization, do not interrupt the supply voltage to the instrument and therefore to the cell.
- In case of prolonged absence (over 2 hours) of the supply voltage, before resuming normal measurement and control operations, repeat the initialization and calibrate the cell.
- In case of shutdown of the system (instrument / installation), remove the cell from its location, rinse it and dry it; in fact a cell immersed and not powered undergoes a process of premature aging.
- While working, the cell must never remain dry.
- The cell must never work in disinfectant-free water, because the electrodes would suffer a depolarization process, the gel electrolyte could be contaminated by bacteria, and consequently the measurement system would be fatally damaged.
- Do not use the sensor in water containing surfactants.

### **Caution:**

- Pay attention to the pressure at which the cell is subjected because the membrane can be damaged both by high pressure and suction pressure.
- Check that there are no air bubbles on the membrane, because they could affect the measurement reliability.
- Regularly check that the membrane is clean and in good condition; if necessary, replace it (see "Maintenance" section).
- Calibrate and check the cell regularly using the DPD1 method, by scheduling these operations at intervals that depend on the specific application and on the required accuracy; a monthly check is recommended.
- The zero adjustment is not required, because it is not affected by the changes of flow rate, conductivity, temperature and pH level.
- A gel electrolyte at temperatures higher than 30-32°C tends to melt and escape from the membrane; for a good performance and duration of a cell working in these conditions, it is recommended to check frequently the electrolyte level (at least once a month) and, if necessary, top it.

## ABOUT THE SENSOR

The CAC cells are membrane covered, amperometric, 2-electrode sensors, with the electrodes immersed in a specific electrolyte. They allow to determine the concentration of active chlorine (inorganic free, total or organic available), which performs a water disinfecting action.

The chlorine diffuses from tested water through the membrane up to the electrolyte, generating a depolarization current of the measurement electrode, proportional to the chlorine concentration. This current is converted by the cell electronics into a standard signal, read by the control unit.

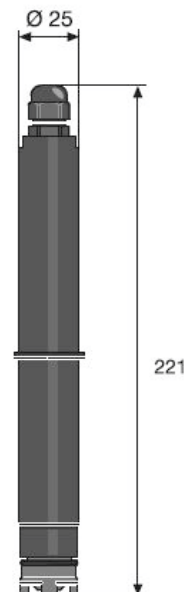
Thanks to the built-in thermo-compensation, the signal is not affected by the water temperature, while the pH influence also depends on the different characteristics of the specific electrolytes and, therefore, acts differently depending on the model (see table in the "Introduction" section).

A full range of cells is available, for use in water purification plants, pool water disinfection or wastewater treatment.

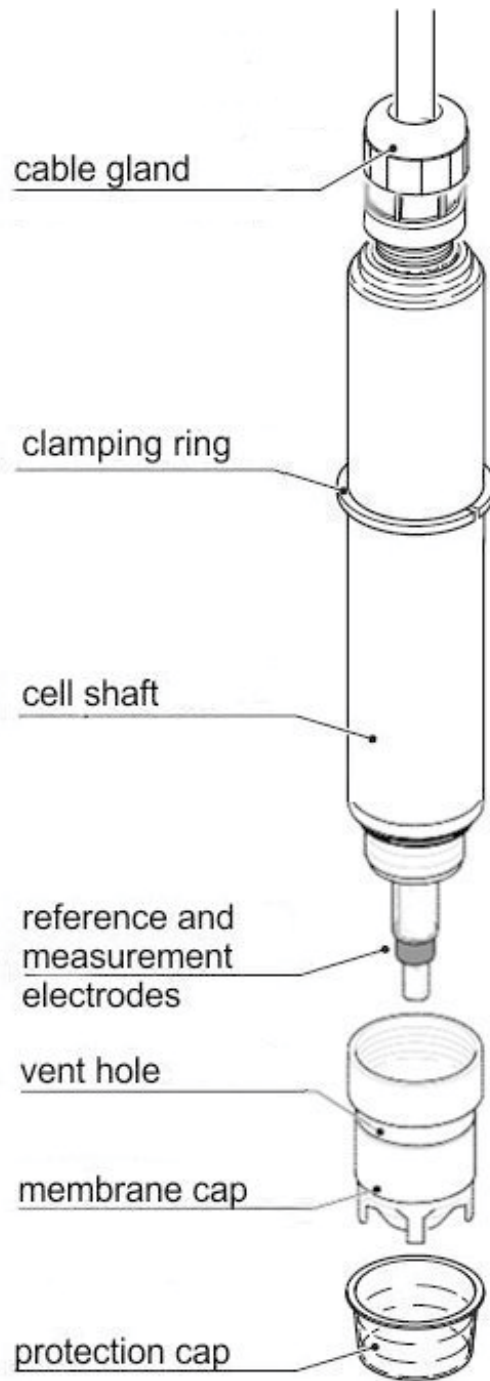
These cells correctly used, provide a continuous and extremely reliable monitoring.

## TECHNICAL DATA

Working Temperature	+5 ... +45°C	
Thermo-compensation	automatic, through built-in sensor, without thermal shocks	
Conductivity of Sample	(aqueous solution) 50 ... 10'000 µS/cm	
Working Pressure	max 1 bar	
Flow Rate	at inlet, through the flow sensor: 40 ... 60 l/h recommended value; 20 ... 100 l/h min ... max flow	
Response Time	T <sub>90</sub> : approx. 60 seconds	
Power Supply	±5 V	
Output Signal	0 ... 2 V	
Connection	4-pole (signal + supply) shielded cable, standard length 1 m	
Materials	PP or PVC cell shaft (depending on model), PPE, PVC or PVDF membrane cap	
Dimensions	dia. 25 x L 221 mm	
Membrane Life	depending on water quality and working conditions, max 1 year	
Protection Rate	IP65	
Storage Conditions	temperature	+5 ... +50°C
	RH max	90% no condensing
	other indications	dust-free area, protected from direct sunlight



# CELL DESCRIPTION



# CELL COMMISSIONING

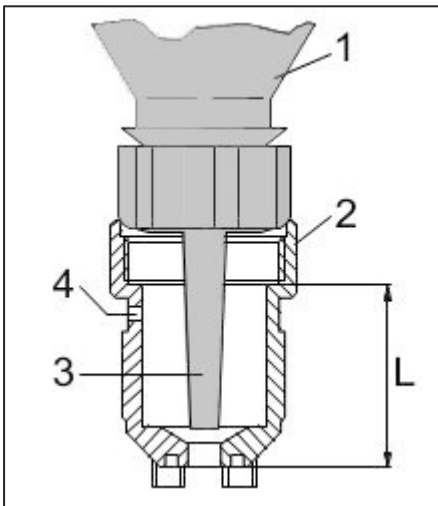
Before use, fill the membrane-cap with the electrolyte.



**Caution!** Do not touch the membrane or the electrodes with your fingers. Do not damage them and avoid any contact with greasy substances.

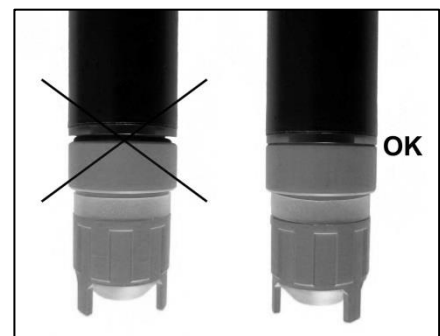
Proceed as follows, also referring to the figure:

- Remove the protection cap and unscrew the membrane-cap from the cell shaft.
- Open the electrolyte bottle, screw the nozzle and expel excess air.
- Rinse the membrane-cap with some electrolyte, then fill it till the indicated level (see the drawing), by avoiding the possible formation of air bubbles.
- Remove any air bubble by lightly tapping the cap on an even surface.
- Place the cell upright onto the filled membrane-cap and screw it by hand **till the stop**, by proceeding slowly for not damaging the membrane and paying attention to not close the vent hole with your fingers, because the excess electrolyte should be able to leak freely.
- Remove the leaked electrolyte with a moist cloth or by rinsing off with water.
- Thoroughly wash the nozzle with warm water.



Legend

1. Electrolyte bottle
2. Membrane-cap
3. Nozzle
4. Vent hole
- L. Electrolyte filling level



## Important Notes

- **To avoid measurement errors, the membrane-cap must be correctly screwed till the stop (see picture).**
- The electrolyte easily oxidizes with air. After use, always keep the bottle closed. Do not transfer to other containers.
- Before use, always check the expiration date on the electrolyte bottle.
- Store the bottle upside-down in vertical position, for pouring the electrolyte easily without forming air bubbles.
- Any small air bubbles in the electrolyte do not interfere with the measurement, while the larger bubbles rise to the top edge of the membrane-cap.



The membrane-cap can be used only once.



## INSTALLATION



For proper operations, the CAC cell must be installed in a special down-flow probe-holder (SD-CP series), equipped with a flow sensor for monitoring the water flow.

In fact, during operation, the sensor should be kept moist and the flow through the probe-holder should never drop below the minimum level (see "Technical Data" section).



Never exceed the maximum working pressure of the cell!

Install the cell into the probe-holder, inserting the seal and fittings in the correct order (see picture, two possible connections on probe-holder) and **positioning the cell at approx. 2 cm from the bottom**. Then screw the threaded rings and tighten by hand.

**Warning!** It is recommended to provide for safety measures and systems, such as a control of the dosing time or redox measurement (upper limit), in order to prevent any damage or erroneous dosage in case of cell malfunctioning.

### Electrical Connections

The cell is provided with a 4-wire (signal + power supply), shielded, direct cable. For connection to the terminal block, please refer to the instruction manual of the electronic unit and follow the below color code:

brown wire	= -5V
white wire	= IN
yellow wire	= GND
green wire	= +5V

Connections are protected against polarity inversion of the power supply.

The instrument associated to the cell must be galvanically insulated from other devices immersed in the same liquid!

## STARTING OPERATION

To obtain a stable and reliable measurement signal, the sensor needs a polarization time, that depends on the type / quality of the measured water and on the temperature.

The average time also varies depending on the cell, as listed in the below table:

Cell	First commissioning	New commissioning	After replacing the electrolyte / membrane
CAC-CLI-XB	1 – 24 h (std. 6 h)	1 – 24 h (std. 6 h)	1 – 3 h
CAC-CLI-B	1 – 24 h (std. 6 h)	1 – 24 h (std. 6 h)	1 – 3 h
CAC-CLI-SW	1 – 24 h (std. 6 h)	1 – 24 h (std. 6 h)	1 – 3 h
CAC-CLI-M1	1 – 3 h	0.5 – 2 h	0.5 h
CAC-CLI-M2	1 – 3 h	0.5 – 2 h	0.5 h
CAC-CLI-A1	1 – 3 h	0.5 – 2 h	0.5 h
CAC-CLI-A2	6 – 12 h (std. 6 h)	0.5 – 2 h (std. 1 h)	0.5 h
CAC-CLO-B	1 – 24 h (std. 6 h)	1 – 24 h (std. 3 h)	3 h
CAC-CLO-M1	1 – 24 h (std. 6 h)	1 – 24 h (std. 3 h)	3 h
CAC-CLO-M2	1 – 24 h (std. 6 h)	1 – 24 h (std. 3 h)	3 h
CAC-CTO-XB	24 h	1 – 6 h	4 – 24 h
CAC-CTO-B	24 h	1 – 6 h	4 – 24 h
CAC-CTO-M1	24 h	1 – 6 h	4 – 24 h
CAC-CTO-M2	24 h	1 – 6 h	4 – 24 h



**Warning!** When using hazardous substances, always take the safety measures indicated in the relevant safety data sheets, which must be updated and available.



**Warning!** Dosing errors due to damaged or old sensor may cause damages to persons and materials! Check, calibrate and maintain the cell regularly, with a frequency that depends on use and on quality of the tested water.

*For details about the calibration procedure, refer to the manual of the electronic unit.*

## MAINTENANCE

Regular maintenance is needed to prevent incorrect dosing due to a sensor failure.

Never touch the electrodes and avoid them to touch greasy substances.

The maintenance intervals depend on the application.

### Operations:

- Regularly check the cell for dirt, algae and air bubbles. Avoid contamination of the membrane by solid deposits as much as possible. Any air bubbles on the external part of the membrane can be eliminated by temporarily increasing the water flow.
- Periodically check the sensor reading on the measurement / control unit, by comparing it with the result of a photometric analysis with DPD method.
  - If necessary, calibrate the cell.
  - If calibration cannot be completed successfully, replace the membrane-cap and recalibrate.
  - If the sensor still displays unstable or too low values, contact the technical service.

### **Replacement of the Membrane-Cap:**

- It is advisable to replace the membrane-cap once a year or when it is not possible to perform a successful calibration, due to unstable or too low readings
  - Unscrew and dispose the membrane-cap.
  - Rinse the electrodes with warm running water to remove any residual electrolyte
  - Leave the electrodes dry windblown, DO NOT RUB !
  - Fill the new membrane-cap with fresh electrolyte (see the “Cell Commissioning” section for details).
  - Screw the cap by hand till the stop, by proceeding slowly for not damaging the membrane and paying attention to not close the vent hole with your fingers, because the excess electrolyte should be able to leak freely.
  - Wait for cell re-polarization, then re-calibrate.

### **Cell Storage:**

- Unplug the cell.
- Depressurize and empty the probe-holder.
- Loosen the locking ring and slowly remove the sensor.
- Unscrew the membrane-cap from the cell shaft and empty it.
- Rinse membrane and electrodes with clean water and leave them dry windblown, making sure that no dust deposits. DO NOT RUB.
- To protect the electrodes, screw a new membrane-cap to the cell, leaving it loose.
- Cover the membrane with the special protective cap.



The cell must be stored dry. In fact a cell immersed and not powered undergoes a premature aging process.

## CELLS AND SPARE PARTS

Item	Description	Code
CAC-CLI-XB	Analysis of active free chlorine, range 0.5 ppm	8061.1100
CAC-CLI-B	Analysis of active free chlorine, range 2 ppm	8061.1101
CAC-CLI-SW	Analysis of active free chlorine in seawater, range 10 ppm	8061.1103
CAC-CLI-M1	Analysis of active free chlorine, range 20 ppm	8061.1104
CAC-CLI-M2	Analysis of active free chlorine, range 50 ppm	8061.1105
CAC-CLI-A1	Analysis of active free chlorine, range 100 ppm	8061.1106
CAC-CLI-A2	Analysis of active free chlorine, range 200 ppm	8061.1107
CAC-CLO-B	Analysis of available/organic chlorine, range 2.0 ppm	8061.1201
CAC-CLO-M1	Analysis of available/organic chlorine, range 10 ppm	8061.1203
CAC-CLO-M2	Analysis of available/organic chlorine, range 20 ppm	8061.1204
CAC-CTO-XB	Analysis of total chlorine, range 0.5 ppm	8061.1300
CAC-CTO-B	Analysis of total chlorine, range 2 ppm	8061.1301
CAC-CTO-M1	Analysis of total chlorine, range 5 ppm	8061.1302
CAC-CTO-M2	Analysis of total chlorine, range 10 ppm	8061.1303
CAC-EL-1	Spare electrolyte for cells CAC-CLI-XB, CAC-CLI-B and CAC-CLI-SW, 100 ml	8061.1021
CAC-EL-2	Spare electrolyte for cells CAC-CLI-M1, CAC-CLI-M2, CAC-CLI-A1 and CAC-CLI-A2, 100 ml	8061.1022
CAC-EL-3	Spare electrolyte for all cells CAC-CTO and CAC-CLO, 50 ml	8061.1023
CAC-ME-1	Spare membrane-cap for cells CAC-CLI-XB, CAC-CLI-B, CAC-CLI-SW and CAC-CTO-XB, blue	8061.1001
CAC-ME-2	Spare membrane-cap for cells CAC-CLI-M1, CAC-CLI-M2 and CAC-CLI-A1, transparent	8061.1002
CAC-ME-3	Spare membrane-cap for cell CAC-CLI-A2, white	8061.1003
CAC-ME-4	Spare membrane-cap for cells CAC-CTO-B, CAC-CTO-M1, CAC-CTO-M2 and all cells CAC-CLO, orange	8061.1004