ITC
DOSING PUMPS

# $Cl_2$ SENSOR 420MB

ENGLISH

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**SAFETY RULES**

In order to prevent personal risks and damages to the environment and to ensure the proper operation of the system, the staff in charge of the systems installation, start-up and maintenance should follow, the instructions of this manual, paying special attention to the explicitly detailed recommendations and warning. They should also follow the specific instructions on the chemicalm products to be dosed.

## 1.-GENERAL DESCRIPTION

Free chlorine amperometric sensor for drinking water and water treatment. Specifically designed to determine the residual level of inorganic chlorine in water.

The chlorine sensor is of the open cell type with no intermediate liquids for the electrochemical reaction, thus facilitating installation and maintenance. Since it is an open sensor it can be used in pressure applications and with solids in suspension.

Manufactured from materials that ensure perfect operation in applications such as:

- Drinking water desininfection
- Industrial processes
- Cooling towers
- Wastewaters reuse

## 2.-TRANSPORT AND HANDLING

The original packaging is designed to ensure that the transport and the storage of the system can be carried out without causing damages to the systems provided these processes are performed inside dry ventilated areas and away from sources of heat.

The packagin includes:
- Free chlorine sensor
- IInstruction manual

## 3.-TECHNICAL FEATURES

- Potentiostatic amperometric sensor for measuring free chlorine

**Measuring cell**
- Analyzable products: $Cl_2$, NaClO, $Ca(ClO)_2$
- 4 electrodes open cell
  - Work Electrode (W)
  - Reference Electrode (R)
  - Counter electrode (C)
  - GND Electrode
- Mesuring range 0.02-3.00 mg/l
- Accuracy: ± 2%
- Polarization time: 30' aprox.
- Electrode cleaning: automatic electrochemical cleaning.
- Cleaning frequency : every 4 hour or every 8 hour

**Working conditions**
- pH 6.5-9.0

Temperature 0-40ºC
Salinity: < 500 ppm $Cl^-$,
<500 ppm $SO_4^{2-}$
Conductivity: 50 - 3000 uS/cm
Maximum pressure: 6 bar
Stable flow

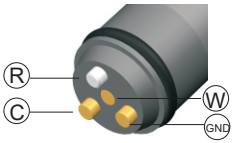
**Power and output signal**
- Power 11 - 26 V DC (70mA)
- Analogical output: 4-20mA
- Serial port output: RS-485 (MODBUS)
- Blue led : reading
- Red led: out of range reading

**Dimensions and materials**
- Protection: IP68
- Dimensions: Ø25mm (1") x 200 mm (7.9")
- Materials:
  - Body: PVC
  - Hydroynamic regulator: PMMA
  - Sealing: FPM
  - Work Electrode (Au)
  - Reference Electrode (Ag/AgCl)
  - Counter electrode (Au)
  - GND Electrode (Au)

## 4.-OPERATION

### 4.1 WORKING PRINCIPLE

Amperometric analysis is based on the measurement of current intensity. This intensity is produced by oxidation or reduction of the analyte when a suitable voltage is applied.

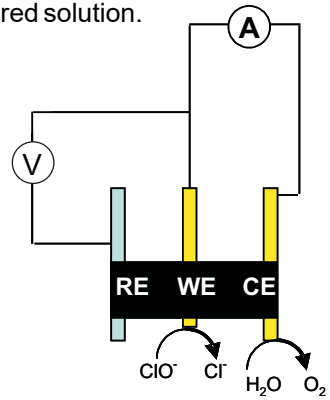



In the case of free chlorine analysis

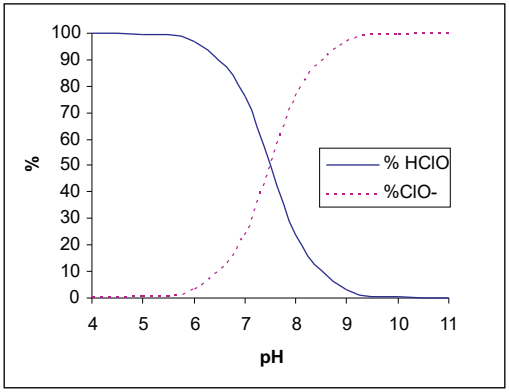
$$HClO + H^+ + 2e^- \xleftrightarrow[\Delta E]{} Cl^- + H_2O$$

As can be deduced from previous reaction, current intensity is proportional to the amount of hypochlorous acid which is present in the measured solution.

Chlorine reduction takes place in the working electrode (W) made of gold. In it the appropriate voltage is applied referred to the reading we get from the reference electrode (R) made of Ag/AgCl. Electric circuit is completed by using an auxiliary electrode (counterelectrode) also made of gold (C). Finally, as measured intensities are very low (on the nanoampere range), in order to keep signal as stable as possible, a fourth electrode is used. This electrode is also made of gold and it acts as a ground.




It is important to bear in mind that hypochlorous acid is a weak acid and therefore the distribution of its species depends greatly on water pH.




At the working voltage, the amperometric sensor not only gives answer to hypochlorous acid but also to hypochlorite. For this reason it is advisable to compensate sensor answer as a function of measured pH in the pH range from 6.5 to 9.0. Out of this range, the existence of parasite reactions on electrode surfaces makes impossible the correction of the acquired readings.

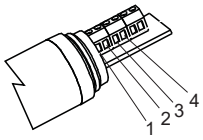
## 4.2.- STATE INDICATION LED

Fix blue LED: measuring
Flashing blue LED-fast (2Hz): automatic cleaning
Flashing blue LED-slow (1 Hz): aconditioning time after cleaning
Fix red LED: reading out of measuring range

## 4.3- OUTPUT 4-20 mA

4-20mA output proportional to free chlorine reading in 0.00-3.00 mg/l range.

Alarm output: 3 mA when the reading is under 00.0 mg/l, 21mA when it is over 3.00 mg/l

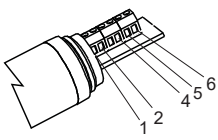



| | |
|---|---|
| 1 | Vin: +11...+26Vdc |
| 2 | Vin: - |
| 3 | 4-20mA: + |
| 4 | 4-20mA: - |

## 4.4- COMMUNICATION OUTPUT RS485 - MODBUS-RTU

### 4.4.1 Description

Communication thorugh (half-duplex) A(+), B(-), y GND (No echo)
Baud rate: 9600
Data bits: 8
Parity: None
Stop bits: 1
Hardware handshaking: No
Character Time out: 100 mSeg.
Message Time out: 2000 mSeg.




| | |
|---|---|
| 1 | Vin: +11...+26Vdc |
| 2 | Vin: - |
| 4 | GND |
| 5 | RS485: A(+) |
| 6 | RS485: B(-) |

### 4.4.2. Data reading (Modbus function 4)

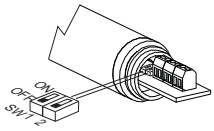
Data map:

| Adress | Name | Format (16bits) | Description |
|---|---|---|---|
| 30001 | State | Unsigned integer | 1: Reading<br>2: Cleaning<br>3: After-cleaning (1')<br>4: After-cleaning (18') |
| 30002 | Reading in nA | Integer | Sensor signal in nA (+/-32768) |
| 30003 | Reading in mg/l | Unsigned integer | Reading in mg/lx100 (ppmx100): 000...300 |
| 30004 | Alarm | Unsigned integer | 0: Reading in the range 0.00-3.00 mg/l<br>1: Reading out of the range 0.00-3.00 mg/l |
| 30005 | Reading in mAx1000 | Integer | 4-20mA proportional reading: 4000...20000 |
| 30006 | Data in Data Logger | Unsigned Integer | Number of data in Data Logger: 0...2048 |

### 4.4.3 Data Logger (Modbus function 3)

Sampling frequency selection:

SW2= OFF: Data Logger off
SW2 =ON: 30'



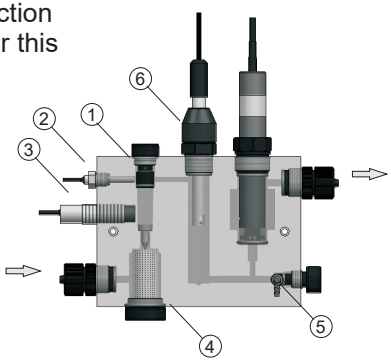

Data map:

| Adress | Name | Format(16bits) | Description |
|---|---|---|---|
| 40001 | First reading | Integer | Readings in mg/l x100 (0...300)<br>Power on: -2 (65534)<br>Empty reading: -3 (65533) |
| ... | ... | ... | |
| 42048 | Last reading | Integer | |

## 5.- INSTALLATION

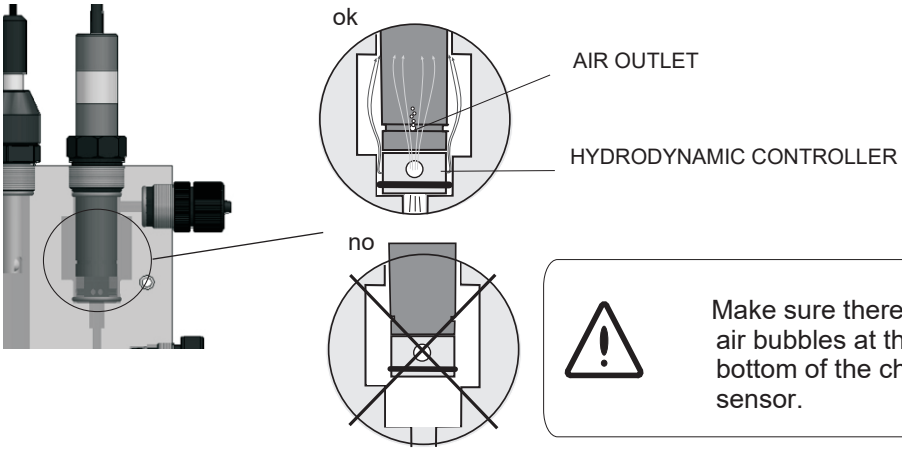
The sensor must be installed where it is possible to ensure a constant flow of water with no chance of air bubbles forming in the measuring cell.

It is recommended that it be installed in the Multifunction Sensor Holder (Ref. 44-020), especially designed for this application, and equipped with the following:



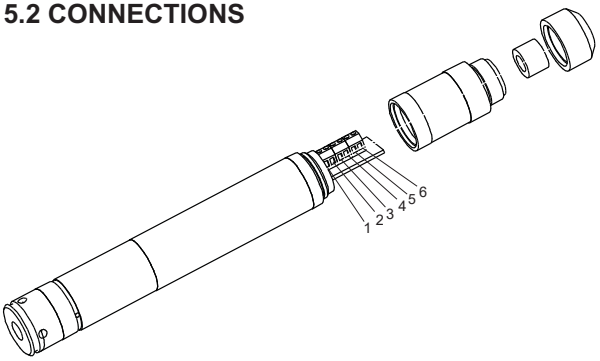

①Flow regulator
②Cavity for temperature sensor
③Flow detector
④Input filter
⑤Sampler
⑥pH sensor cavity

## 5.1 INSTALLATION IN MULTIFUNCTION SENSOR HOLDER Ref. 44-020




Make sure there are no air bubbles at the bottom of the chlorine sensor.

## 5.2 CONNECTIONS




| | |
|---|---|
| 1 | Vin (+) 11-26 VDC |
| 2 | Vin (-) |
| 3 | 4-20mA (+) |
| 4 | 4-20mA (-)/RS485 (GND) |
| 5 | RS485 A (+) |
| 6 | RS485 B (-) |

## 6.- START-UP

### 6.1 SENSOR CONDITIONING

If it has not been used recently or if it is being connected for the first time, the sensor will requier a conditionning time. Prior to sensor calibration, insert the sensor correctly into the sensor holder and let the water containing free chlorine flow for 24 hours to ensure that the cell is properly polarized. If the system start up can not be delayed 24 hours, wait one hour before calibration, and repeat the calibration after 24 hours.

### 6.2 SENSOR CALIBRATION

First point calibration: 0 ppm
Once the sensor is properly conditioned let the water flow at 0 ppm until a stable reading is achieved.

To facilitate the calibration at 0 mg/l, the user should have an active carbon filter in by-pas before the sensor holder. This makes it possible to easily have the water at 0 ppm.

Second point calibration:
Let the water with free chlorine flow for ten minutes.

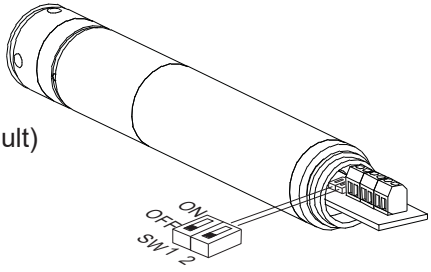
Take a sample of the water flowing around the sensor holder with the chlorine sensor, carry out a DPD-1 analysis in oder to determine the free chlorine level of the sample, and then to introduce this value into the control device.

## 7.- MANTENANCE

### 7.1 CLEANING AND CALIBRATION

Cleaning interval:
Using Sw1 it is possible to select the automatic electrochemical cleaning interval:

SW1= OFF: every 8 hours (default)
SW1=ON: every 4 hours




Calibration's interval:
The firts time, after 24 hours.
The other times, it depends of water conditions:: betwin 1-4 weeks

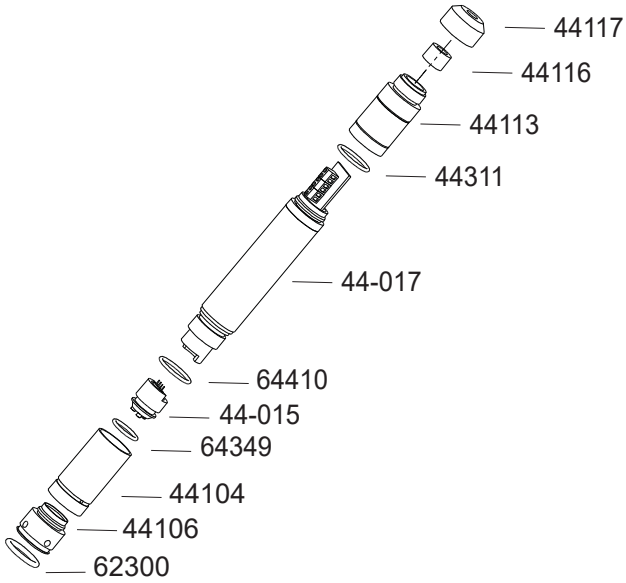
After disconnecting the system, wait 60 minutes for the correct polarization of the sensor. Calibrate, and after 24 hours repeat the calibration

**If the sensor has been working at 0 mg/l, without water flow, or without water, for 1 hour or more,** an electrochemical cleaning will have to be carried out. Then condition and calibrate the sensor once again.

**The sensor can be passivated if it has been working for hours at over 3 mg/l**. Clean the sensor introducing it into a HCl 0.1M solution for 20 seconds.Then conditioning and calibrate again the sensor.

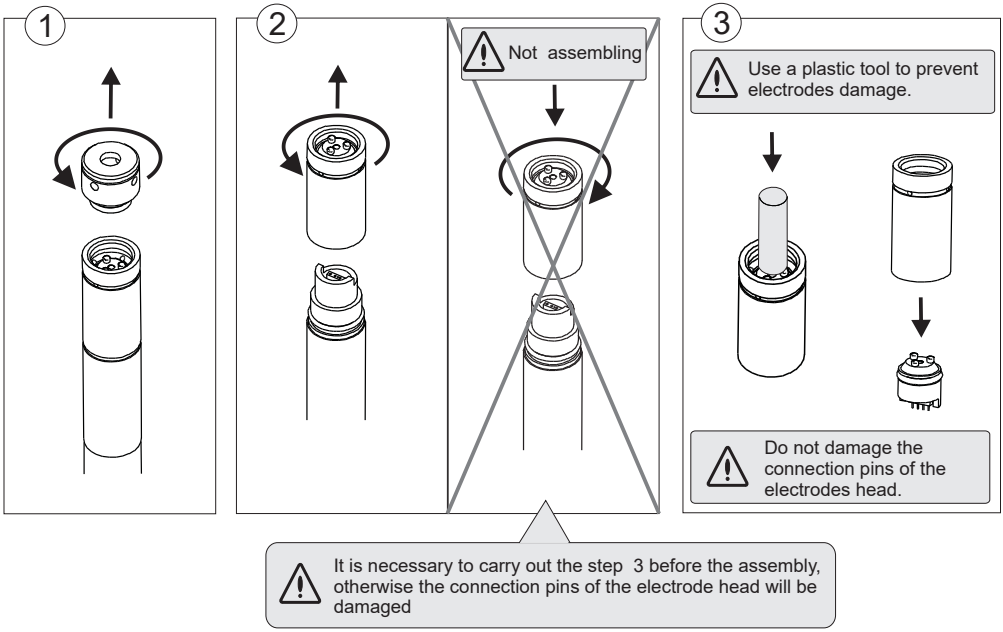
## 7.2 SPARE PARTS

| CODE | DENOMINATION |
|---|---|
| 44-015 | Electrodes head of chlorine sensor |
| 44-017 | Body assembly of chlorine sensor 420MB |
| 44104 | Ring holder for electrodes base |
| 44106 | Hydrodynamic flow regulator |
| 44113 | Ending ring of chlorine sensor 420MB |
| 44116 | Silicon seal 6x10x10 |
| 44117 | Cable gland of chlrine sensor 420MB |
| 44311 | O-ring 17x1.5 NBR |
| 62300 | O-ring 19x3 FPM |
| 64349 | O-ring 14x2.5 FPM |
| 64410 | O-ring 19x2 FPM |

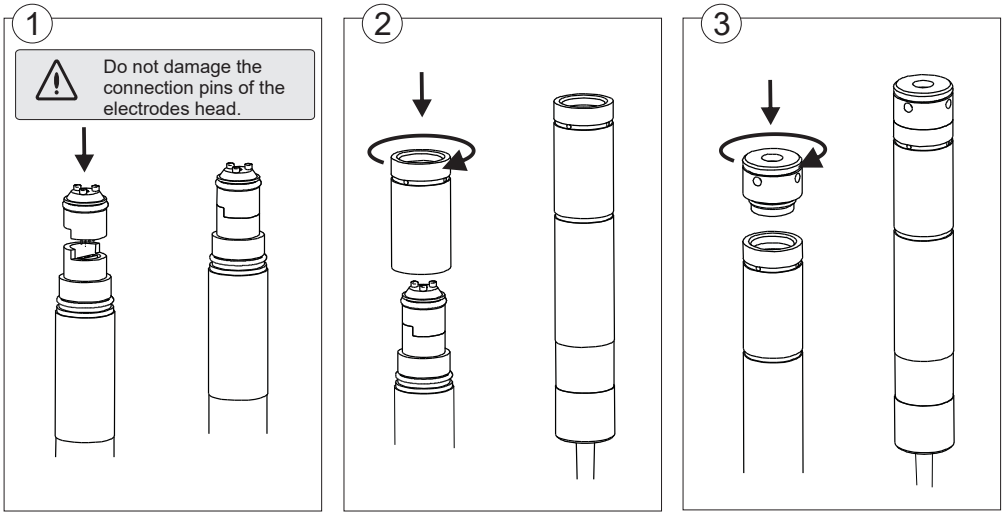


## 7.3 ELECTRODES HEAD REPLACE

### Disassembling




### Assembling



## 7.4 PROBLEM - CAUSE - SOLUTION

| PROBLEMS | CAUSE | SOLUTION |
|---|---|---|
| READING mg/l = 0, WITHOUT COINCIDENCE WITH DPD-1 MESURE | Sensor fails to connect with control device | - Check connections |
| | Insufficient flow in sensor holder, or the chlorine sensor not in contact with the water | - Adjust the flow that reaches the sensor holder. Clean the sensor holder's filter and flow regulator. |
| | Air bubbles in the sensor measurement zone. | - Purge the sensor holder and ensure that no air is left in the measurement zone. |
| | The sensor has been measuring water without free chlorine for a few hours | - Lef the water containing free chlorine flow around the sensor hlder for 1 hour. |
| READING LOWER THAN THE DPD-1 MESURE | Insufficient flow in sensor holder | - Adjust the flow that reaches the sensor holder. Clean the sensor holder's fliter and flow regulator. |
| | Air bubbles in sensor measurement zone. | - Purge the sensor holder and ensure there is no air in the measurement zone. |
| | The sensor is passivated due to working at over 3 mg/l | - Repeat sensor conditioning and calibrate once again. Carry out an electrochemical cleaning. |
| | The pH of the water is higher that at the moment of the calibration, and there is no pH measurement in the control device. | - Calibrate the sensor by introducing the correct pH value or install a pH sensor to perform an automatic compensation. |
| | The pH is over 9, and thus it is outside the compensation zone. | - Adjust the pH iwithin the admissible pH margin: 6.5-9 |
| READING HIGHER TO THE DPD=1 MEASUREMENT | The sensor has been calibrated without waiting for the sufficient conditioning time. | - Repeat sensor conditioning and make a new calibration |
| | DP-1 reagents used-up | - Repeat DPD-1 with new reagents. |

| PROBLEMS | CAUSE | SOLUTION |
|---|---|---|
| | DPD-1 measurement incorrect due to a high-salinity water sample | - Increase the waiting time for the reaction of the DPD-1 measurement reagents. |
| | Sensor seal failure. | - Check sensor seal joints |
| | The water's pH is lower than at the moment of calibration. | - Calibrate the sensor at current pH |
| | The pH is under 6.5, and thus is outside the compensation zone. | - Adjust the pH within the admissible pH margin: 6.5-9. |
| | Sensor fails to connect with control device. | - Check connections |
| UNSTABLE MEASUREMENT | The water flow reaching the sensor holder is unstable and the flow regulator doesn not work. | - Stabilize pressure in the tubes where the sample is taken for the sensor holder and check the flow regulator. |
| | Air bubbles in the sensor measurement zone. | - Purge the sensor holder and ensure that no air is left in the measurement zone. |
| | External electrical interferences | Eliminate the disturbance source. Connecting water to ground could helps |
| | interferences by other oxidizing elements | - Do not use more the one oxidizer for disinfecting the water |
| | The pH is unstable | -Stabilize the pH |

## *EC CONFORMITY DECLARATION*

*I.T.C S.L..*
*Vallès, 26*
*Polígono Industrial Can Bernades-Subirà*
*08130 Santa Perpètua de Mogoda*

*Declares that the Sensor of Free Chlorine identified with the Serial Number and Year of Manufacture fulfil the Low Voltage Directive Electromagnetic Compatibility D89/336/CE, as long as the Installation, the Use and the Maintenance will be executed in accordance with the current rules and following the instructions of the Manual.*

*Antón Planas*
*Manager*

## WARRANTY

ITC DOSING PUMPS

***ITC** warrants the Product specified in this Document for 1 year period from the Purchase Date (except the parts that suffer wear as valves, joints, connections, hoses and filters), against any manufacture or material Defect, and as long as the Installation, Use and Maintenance have been correct.*

*The Equipment must be sent, all inclusive charge, to our workshop or to the authorized ITC Technical Service, and its Return will be executed carriage forward.*

*The Equipment must be accompanied by the Warranty Document with the Purchase Date and the stamp of the Seller's Establishment, or a copy of the Account of goods purchased.*

*MODEL*
_____

*SERIAL NUMBER:*
_____

Purchase Date and Stamp of the Seller's Establishment

DATE: _____

Original manual Ed: 03.07.19-EN

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DOSING PUMPS

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