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CLDTX-100 Series

SECTION 1.0
THEORY OF OPERATION

1.0 CHLORINE DIOXIDE INTRODUCTION. Chlorine dioxide is considered one of the most powerful biocides available today. It is so effective that it was used to disinfect sites infected with the SARS virus and is used to disinfect areas know to be contaminate with Legionella sp. One of the most important properties of ClO2 that sets it apart from chlorine is its behavior when placed in water. Not only is ClO2 10 times more soluble in water than chlorine (3.01 grams/Liter at 25 degrees C), it doesn't hydrolyze when placed in solution. It remains as a "true" dissolved gas that retains its useful oxidative and biocidal properties throughout the entire 2 to 10 pH range.

1.2 SENSOR OPERATING PRINCIPLE. Chlorine dioxide gas diffuses across the sensor's hydrophobic silicone membrane between the cathode and electrolyte solution. At the applied potential, it is electrochemically reduced at the gold cathode as:

$ClO2 + 4H^+ + 5e- \text{ ---> } Cl^- + 2\ H_2O$

At the same time, the silver anode is oxidized to form silver chloride (AgCl) as:

$Cl^- + Ag \text{ ---> } AgCl + e-$

The release of electrons at the cathode and acceptance at the anode creates a current flow, which under constant conditions, is proportional to the chlorine dioxide concentration in the medium outside the sensor. The resulting low current output is then conditioned to 4-20mA current by the sensor's onboard electronic circuitry.

SECTION 2.0
FACTORS INFLUENCING THE SENSOR

2.1 pH. As dicussed in Section 1, there is no significant pH dependence when measuring ClO2.

2.2 Chemical Interferences. The sensor should not be used in water containing surfactants.

2.3 FLOW. The membrance covered chlorine dioxide sensors (CLD series) function at any flow rate. To acheive reproducible measurements, these sensors require a specified constant flow rate. To avoid complications (such as bubbles), it is best to operate the sensors at a flow rate of 0.2-0.6 gpm.

Parts covered by this product instruction sheet include: CLDTX-100 Series

SECTION 3.0
SENSOR PREPARATION

3.0 CHLORINE DIOXIDE SENSOR ASSEMBLY. Your Chlorine Dioxide sensor is shipped with the membrane cap (CLDA-2016) pre-installed and covered with a cap with water inside to keep the membrane wet.
NOTE: IF SENSOR WILL BE STORED DRY OUT OF FLOW CELL, SHAKE BODY DOWNWARD INTO A SINK TO REMOVE THE FILL SOLUTION. TAKE THE MEMBRANE CAP AND IMMERSE IN A CUP OF TAP WATER UNTILL READY TO REUSE. SEE SECTION 9. REPLACE CAP AND ELECTROLYTE BEFORE INSTALLING INTO FLOW CELL (see SECTION 10 for cap and electrolyte change. See SECTION 5 for sensor installation into flow cell).

SECTION 4.0
FLOW CELL INSTALLATION

4.0 FLOW CELL. To obtain accurate Chlorine dioxide reading, the Sensor must be installed into the Flow Cell to prevent air bubbles formation on the membrane, proper spacing between the sensor and the installation wall, and laminar flow across the membrane.

4.1. Using two 1/4" NPT Tube fittings, connect the Flow Cell into your system, noting the inlet (bottom) and outlet (side) orientation. (see FIGURE 1)

4.2. Install clamp with rubber backing as shown in FIG. 2.
4.3 Drill 3/8" diameter hole on the panel.
4.4 Insert bolt as shown in FIG 2
4.5 On back of panel attach lock washer and nut to secure clamp and flow cell to panel.

SECTION 5.0
SENSOR INSTALLATION

5.0 SENSOR INSTALLATION INTO FLOW CELL.

a. First install threaded fitting onto sensor body (remove fitting if pre-installed in flow cell)
b. Install snap-ring into groove on sensor body
c. Next, slide o-ring onto body of sensor until it reaches bottom of threaded fitting.
d. Thread sensor assembly into top of flow cell as shown in FIGURE 2.
d. Turn on flow and verify the flow through the Flow Cell is at least 0.2gpm (45 liters/hour and no more than 0.6gpm (135 liters/hour).

FIG.1

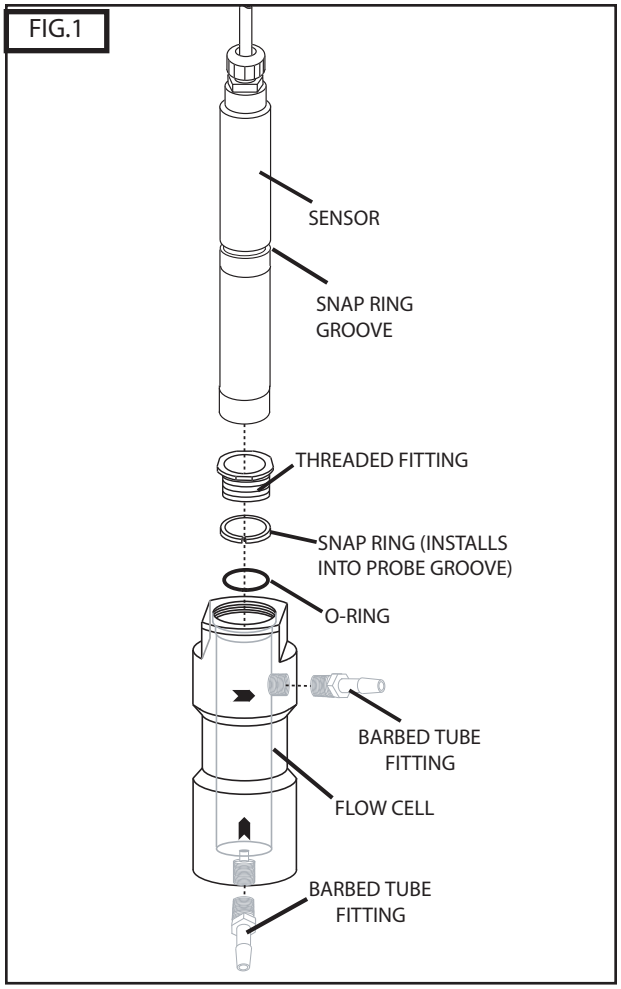
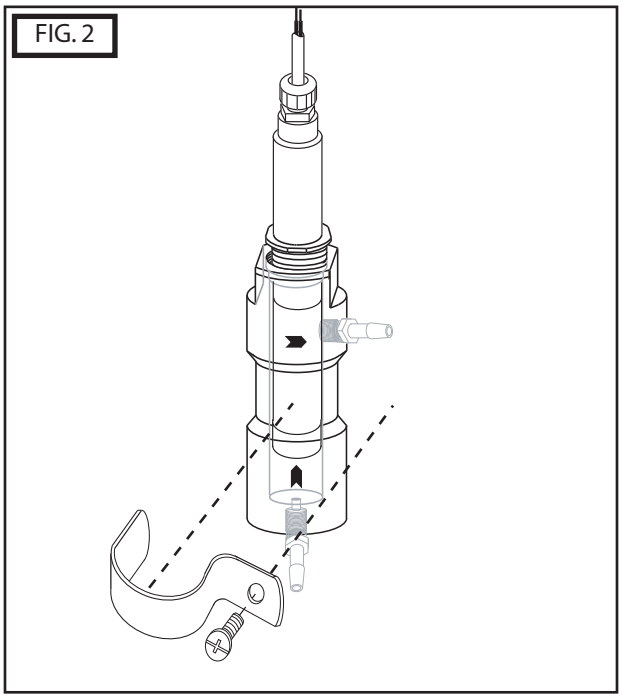


FIG. 2



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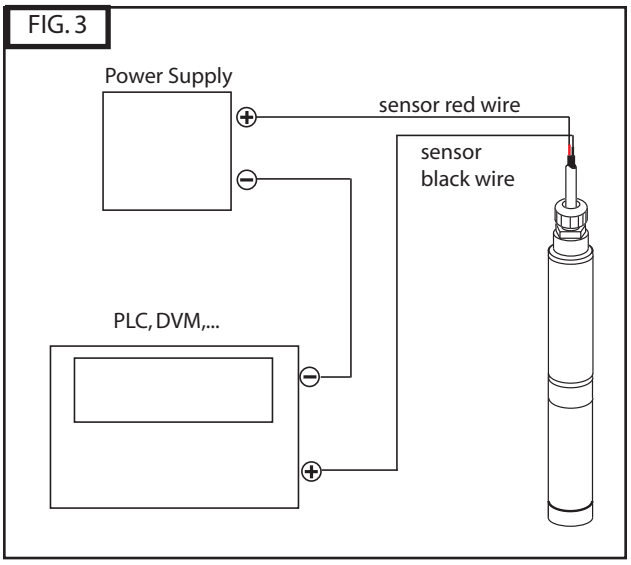
SECTION 6.0
ELECTRICAL INSTALLATION

6.0 ELECTRICAL INSTALLATION. The sensor produces an approximate output of 4 mA in air and 20mA at the top range of chlorine dioxide output (0-1ppm, 0-2ppm, 0-5ppm).

NOTE: The supply voltage to the Sensor must be 12-24 V DC with minimum of 250 mA. Maximum load is 1 Watt. The sensor has 3 wires, red (+) , black (-) and clear (shield). Twist together or solder black and clear if instrument does not have separate ground. If a separate ground is available such as for PLC's connect clear (shield) to it. Attach the red wire to the power supply positive terminal (+)and the black wire to the PLC or DVM positive (+) terminal. Connect a wire (customer supplied) from the power suppy negative (-) and the PLC or DVM (-). See FIG 3. The Sensor will require several minutes to stabilize after power is supplied to it.

FIG. 3



SECTION 7.0
SENSOR CONDITIONING

7.0 SENSOR CONDITIONING The sensor requires conditioning prior to generating stable values.

a. For new Sensors, allow the Sensor to run for at least hours before calibration.
b. If the Sensor will be un-powered for 2 hours or more, run for 3 hours prior to use.
c. After membrane/electrolyte replacement, allow the Sensor to run for at least 4 hours.

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SECTION 8.0
CALIBRATION

IMPORTANT NOTE: SENSORS ARE SUPPLIED FACTORY CALIBRATED WITH A 4-20mA SIGNAL OUTPUT CORRESPONDING TO THEIR SPECIFIC RANGE (0-1, 0-2 OR 0-5ppm ClO2). SPAN CALIBRATION IS NECESSARY WHEN RECEIVING A NEW SENSOR SINCE YOUR CONDITIONS MAY VARY FROM THOSE USED AT THE FACTORY FOR SPAN CALIBRATION. THE ZERO POINT CALIBRATION IS NOT NECESSARY SINCE THE ZERO SETTING IS VERY STABLE.

PERIODIC CALIBRATION (ABOUT ONCE PER WEEK) IS RECOMMENDED. THIS USEFUL IN TRACKING SENSOR FAILURES AS WELL.

8.1 Removal of cord grip to access ZERO and SPAN potentiometers inside the sensor body:

a. Remove top nut of cord grip as shown in FIGURE 4.
b. Remove remaining cord grip as shown in FIGURE 5. A wrench may be required.

8.2 Slope Calibration:

a. Determine the chlorine dioxide (ClO2) concentration using a diethyl-p-phenylenediamine (DPD) colorimeter test kit (see FIGURE 9.), not included with ClO2 sensor and flow cell.
b. Measure Chlorine dioxide content with sensor. Make sure that calibration flow rate matches flow rate when measuring sample since probe output is flow rate dependent.
c. Adjust the span potentiometer to the desired mA (see FIGURES 9 & 9A)
c. Repeat this slope calibration one day after sensor is initially installed.
d. Routinely repeat the slope calibration monthly.

SECTION 9.0
SENSOR STORAGE

9.0 STORAGE. Store sensor at 5º C- 50º C ONLY. and maximum humidity of 95% non-condensing.

a. *Short Term Storage* (1 week or less): Store in Flow cell with water to prevent the probe from drying out.
b. *Intermediate Term* (1 week to 1 month): Store in cap, bottle, or beaker with water to keep membrane wet.
c. *Long Term* (1 month or longer): Remove Membrane Cap and store completely immersed in tap water. Turn sensor upright and shake it to remove fill solution from inside the sensor.

FIG. 4

FIG. 5

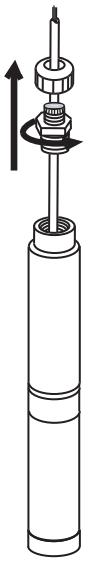


FIG. 6

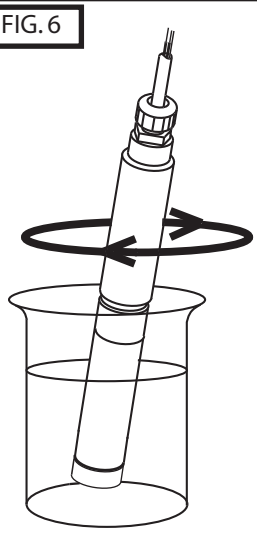


FIG. 7

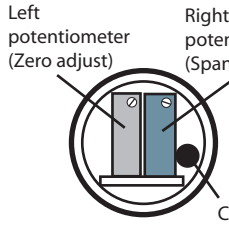


FIG. 8

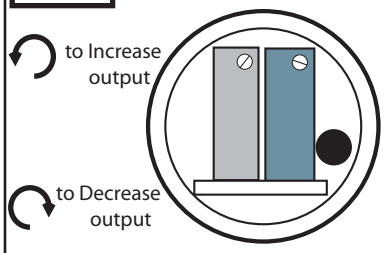
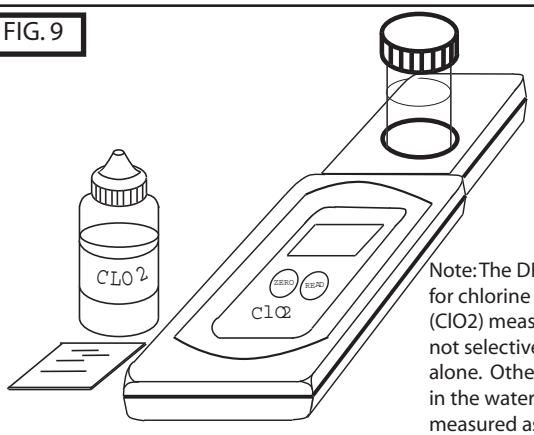


FIG. 9



Note: The DPD method for chlorine dioxide (ClO2) measurement is not selective for ClO2 alone. Other oxidants in the water can also be measured as ClO2.

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SECTION 10.0
SENSOR MAINTENANCE/ RECONDITIONING

10.1 MEMBRANE CAP REPLACEMENT. If membrane replacement is required, a new cap with preinstalled membrane must be used. Order CLD-2016(see Section 12) Cap/membrane replacement.
To change membrane cap:
a) turn sensor upside down with cap facing upward
b) rotate cap counter-clockwise to remove (see FIG 10).
c) fill sensor body with electrolyte using needle and bottle of refill solution (see FIG. 11)
d) install new membrane cap by threading cap onto sensor rotating cap clockwise (opposite of FIG 10)

SECTION 11.0
SENSOR TROUBLESHOOTING

11.1 CALIBRATION PROBLEMS

a) Sensor output *HIGHER* than DPD test
1) Run in time too short
2) Membrane cap damaged
3) Interference from water contaminants (see Specifications, "Cross Sensitivity")
4) Cable short circuit or damage

b) Sensor output *LOWER* than DPD test
1) Run in time too short
2) Deposits on Membrane cap
3) Flow rate too low
4) Air bubbles on membrane
5) Surfactants in water
6) No electrolyte in membrane cap

c) Sensor ouput is 4mA (zero ppm)
1) Run in time too short
2) Chlorine dioxide content below detection limit
3) Sensor not wired correctly (See SECTION 6.0 of this manual)
4) Defective sensor

d) Sensor output *UNSTABLE*
1) Air bubbles on membrane
2) Membrane damage
3) Non-sensor problem

FIG. 10

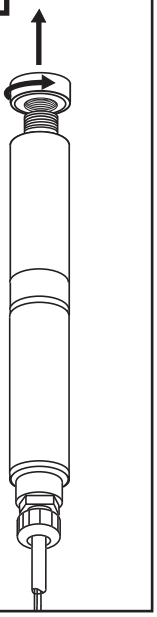
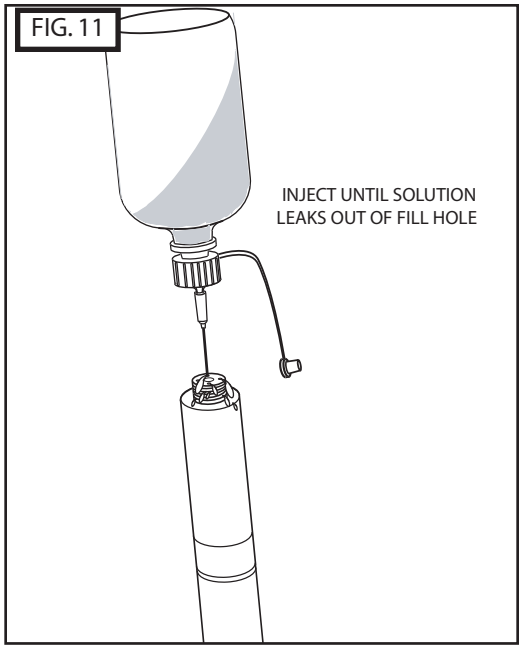


FIG. 11



TROUBLESHOOTING CHART

Symptom	Possible Cause	Solution/Remedy
The sensor cannot be calibrated- ouput is *HIGHER than* DPD Test	1) Run in time too short 2) Membrane cap damaged 3) Interference from contaminants 4) DPD chemicals bad 5)Temperatue increased since cal	1) See Sec 5.0 -CONDITIONING 2) Replace cap - See Sec 8.0 3) See SPECIFICATIONS 4) Use new DPD kit 5) Match calibration temp.
The sensor cannot be calibrated- output is *LOWER than* DPD Test	1) Run in time too short 2) Deposits on membrane cap 3) Flow rate too low 4) Air bubbles on membrane 5) Surfactants in water 6) No electrolyte in cap 7) Temperature decreased since cal 8) Organic chlorination agents present in water	1) See Sec 7.0 -CONDITIONING 2) Remove deposits or replace cap if cleaning ineffective. 3) increase flow - See SPECIFICATIONS 4) Remove and re-install sen sor to remove bubbles. 5) Remove surfactants and replace cap 6) Add new electrolyte, run in sensor and re-calibrate 7) Increase temp to match cal 8) Use chlorinating agents per DIN 19643
Sensor output is 4mA (0 ppm)	1) No ClO2 present` 2) Run in time too short 3) ClO2 content below limit 4) No electrolyte in cap 5) Sensor electrical connection wrong	1) Check for ClO2 with appropriate DPD test. 2) See Sec 7.0 -CONDITIONING 3) Add ClO2, check genera- tor and repeat calibration 4) Refill electrolyte 5) See SECTION 6.0
Unstable output from sensor	1) Air bubbles on sensor membrane 2) Membrane damaged 3) Non-sensor problem	1) Tap to remove bubbles 2) Replace membrane, run in sensor and recalibrate. 3) check PLC or I/O device

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SECTION 12.0
SENSOR SPECIFICATION

12.1 OPERATING SPECIFICATIONS. Follow all operating specifications, especially for pH and flow rate as noted in the specification tables below.

TECHNICAL SPECIFICATIONS

SENSOR	
Dimensions:	8.2"L x 1" dia
Body Material:	Black PVC
Membrane Material:	Silicone
O-ring material:	Viton®
Cathode:	Gold
Anode:	Silver chloride (AgCl)
Cable:	2 -conductor shielded, 10ft (3mtr) tinned wire leads
FLOW CELL	
Dimensions:	5.58"H x 2.25"DIA
Material:	Acrylic
Connections:	1/4" NPT inlet and outlet

OPERATING SPECIFICATIONS

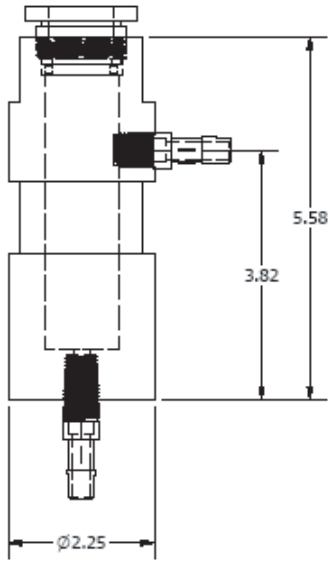
Operating temperature range:	0-45 degC
Maximum operating pressure:	1 bar/14.5 psi/1atm
Flow rate minimum:	.20 gpm
Flow rate maximum:	0.6 ppm
pH range:	4-11
Output signal:	4.0+/- 0.2mA in air (zero) 20mA +/- 0.2mA at high range (2, 5 or 10ppm)
Power Requirement:	12-24 VDC, *250* mA minimum
Cross-Sensitivity:	

Do not operate the Sensor in surfactant water. Surfactant water will reduce life of Sensor.

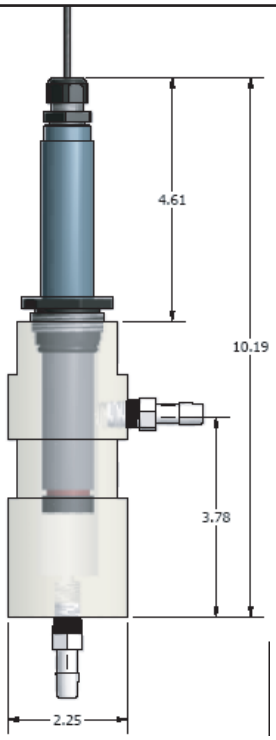
MAINTENANCE/REPLACEMENT PARTS

FC72	Flow Cell, 1/4 inch FNPT inlet and outlet, includes: 2 each 1/4" barbed tube fittings, clamp, threaded flow cell installation fitting
CLD-ES	Chlorine dioxide sensor fill solution, 30mL, 1 each
CLD-RM	CLD sensor replacement premembraned cap, 1 each

FC72 FLOW CELL DIMENSIONS



SENSOR AND FLOW CELL INSTALLATION DIMENSIONS



1 YEAR WARRANTY

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