



DEPOLOX® 3 plus RESIDUAL ANALYZER

The USFilter's Wallace & Tiernan Products (USF/W&T) Depolox® 3 plus residual analyzer continuously measures free or total (combined) chlorine (or chlorine dioxide or ozone) in drinking water applications. Utilizing proven and universally accepted amperometric measurement technology, this analyzer directly measures these disinfectant residuals and provides a 4-20 mA output signal for control or recording purposes. Integral alarm relays are included. The analyzer is also available in an arrangement for measuring pH or fluoride.



FEATURES

- Chlorine Measurement Without Reagents - Utilizing a unique, internally buffered sensor, the Depolox 3 plus residual analyzer measures free or total chlorine residuals without the need for reagents. This includes samples with varying pH. Since no chemicals are added, the sample can be added back to the supply or simply drained without concern for discharge restrictions.
- Three-Electrode Measuring Cell - For free and total chlorine, chlorine dioxide and ozone, a three-electrode-technology measuring cell is used. This cell eliminates the need for the constant zero adjustment typical of other analyzers. Reliability and stability are vastly improved while maintenance is dramatically reduced. Calibration and accuracy are not affected by changes in turbidity or conductivity.
- Flexible Arrangements - The electronic controls and the wet side are separate to simplify installation and provide for operator convenience. There are two wet side configurations available: one for the membrane-type cell used for free or total chlorine, chlorine dioxide, or ozone, and one for the "bare-electrode" type of cell used for free chlorine only. Both of these wet sides can be fitted with a sensor for measuring pH or fluoride. For fluoride-only measurement, there is a separate flow-through assembly. There are two electronic controls units available: a single input version for disinfectant-only measurement and a dual-input version for disinfectant and pH or fluoride measurement.
- Advanced Electronics - Housed in a NEMA 4X enclosure, the analyzer controls provide an isolated 4-20 mA out-

put, configurable alarm relays, and an RS-485 digital interface for the most sophisticated control schemes. A sunlight readable, backlit LCD display features two lines of characters to provide such information as residual level and type of residual, alarm messages, etc. A six-button keypad provides access to the various displays, as well as set-up, calibration, and diagnostic menus. A security code can be selected to prevent unauthorized access to the operating parameters.

- Sample Flow Switch - An optional flow switch is available to indicate when there is a loss of flow to the measuring cell. This switch mounts on the inlet of the flow cell and can be wired to the electronic controls to provide an alarm indication of a loss of sample.



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OPERATION

MEMBRANE-TYPE MEASURING CELL

There are four disinfectant-specific, membrane-type sensors available for measuring either free chlorine, total chlorine (also called combined chlorine), chlorine dioxide, or ozone. The sensor, mounted in the flow-through wetside, includes a membrane-covered, potentiostatic, three-electrode system. The silver/silver chloride reference electrode (silver/silver iodide for total chlorine) and the gold working electrode are positioned inside the membrane cap, which is filled with an oxidant-specific electrolyte solution. The stainless steel counter electrode is located outside of the membrane cap for added stability. The disinfectant, diffusing through the membrane, causes a reaction at the working electrode, creating a current, which is a direct measure of the residual level. An amplifier in the electrode shaft conditions this signal including temperature compensation and passes it to the microprocessor-based control electronics. The sensor

is designed such that a zero residual value will yield zero current. Therefore, only a single point calibration is required. The sensor has a very low dependence on pH value, so it can be used on potable water samples with varying pH.

The flow block assembly housing the membrane sensor is designed to provide a constant flow of water past the membrane surface. Since any air bubbles on the membrane may result in a false reading, a water jet, designed into the flow block, removes any air bubbles from the membrane. This, combined with the three-electrode cell technology, ensures accurate and repeatable measurements.

BARE-ELECTRODE TYPE MEASURING CELL FOR FREE CHLORINE

For free chlorine measurement only, an alternative wetside is available utilizing bare-electrode measurement technology. This arrangement can be used where a quick response time is required or if there is high hardness in the sample water that could foul a membrane sensor. The wetside consists of a three-electrode system with an external potentiostatic closed-loop control. The working electrode and the counter electrode are made of a platinum alloy. A silver/silver chloride electrode serves as a reference electrode, which is mounted in PVC brackets and completely submerged in electrolyte. The measuring cell is connected to a digital amplifier, which maintains an adjustable constant potential between working and reference electrodes by means of potentiostatic closed-loop control. The current generated



Bare-Electrode Measuring Cell

in the measuring cell is directly proportional to the free chlorine concentration in the sample and is passed on to the microprocessor-based control electronics.

This type of measuring cell requires a constant pH. For samples with a varying pH, a CO₂ gas reagent kit is available for economical pH adjustment. As an alternative, the dual input configuration, with pH as the second measurand, can be configured to



Membrane-Type Measuring Cell



Membrane-Type Cell with pH or Fluoride Probe



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apply the pH value to the free chlorine signal and calculate the residual value based on the chlorine/pH disassociation curve. This eliminates the need for buffering.

The flow block assembly consists of a transparent Plexiglas body. A regulated sample flow through this assembly supports a special kind of cleaning grit that continuously cleans the electrode surfaces to maintain accurate and repeatable measurements.

pH AND FLUORIDE MEASUREMENT

The method for measuring pH and fluoride-ion concentration is similar to that for measuring chlorine, except that ion-selective probes are used instead of the amperometric measuring cell. The pH sensor is hydrogen-ion selective in conjunction with a silver/silver chloride reference electrode. The fluoride sensor is a fluoride-ion selective electrode also in conjunction with a silver/silver chloride reference electrode.

Both are impervious to interference by other ions, even in large quantities.

The flow block assembly for either the membrane or the bare-electrode-type wetside can be fitted with a pH or fluoride probe. A dual input electronic controller is used for processing both the disinfectant measurement and either the pH or fluoride measurement. For fluoride measurement only, a flow-through probe assembly is used instead of the disinfectant wetside.

TECHNICAL DATA

DISINFECTANT MEASUREMENT

Measurand	Free Cl ₂ (membrane)	Total Cl ₂	ClO ₂	O ₃	Free Cl ₂ (Bare electrode)
Range	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-10 mg/l	0-0.20 to 0-20 mg/l
Accuracy	0.05 mg/l or ±6% F.S. Whichever is greater	0.05 mg/l or ±6% F.S. Whichever is greater	0.05 mg/l or ±6% F.S. Whichever is greater	0.05 mg/l or ±6% F.S. Whichever is greater	0.01 mg/l or ±2% F.S. Whichever is greater
Sensitivity	0.01 mg/l or ±1% F.S. Whichever is greater	0.01 mg/l or ±1% F.S. Whichever is greater	0.01 mg/l or ±1% F.S. Whichever is greater	0.01 mg/l or ±1% F.S. Whichever is greater	0.01 mg/l or ±1% F.S. Whichever is greater
Repeatability	0.02 mg/l or ±3% F.S. Whichever is greater	0.02 mg/l or ±3% F.S. Whichever is greater	0.02 mg/l or ±3% F.S. Whichever is greater	0.02 mg/l or ±3% F.S. Whichever is greater	0.01 mg/l or ±2% F.S. Whichever is greater
Stability	±5% F.S. under typ. Conditions for 1 month	±5% F.S. under typ. Conditions for 1 month	±5% F.S. under typ. Conditions for 1 month	±5% F.S. under typ. Conditions for 1 month	2% F.S. under typ. Conditions for 1 month
Response Time	90% change <5 minutes	90% change <5 minutes	90% change <20 seconds	90% change <50 seconds	90% change <20 seconds
Sample Temperature	41° to 113° F (+5° to 45° C)	41° to 113° F (+5° to 45° C)	41° to 113° F (+5° to 45° C)	41° to 113° F (+5° to 45° C)	41° to 122° F (+5° to 50° C)
Sample Flow (Potable Water Only)	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	33 l/h ± 5 liter, constant
Inlet Pressure	0.15 to 4 bar	0.15 to 4 bar	0.15 to 4 bar	0.15 to 4 bar	0.15 to 4 bar
Outlet Pressure	0 bar	0 bar	0 bar	0 bar	0 bar
Conductivity	>10 µS/cm up to 2500 µS/cm	>10 µS/cm up to 2500 µS/cm	>1 µS/cm up to 40 µS/cm	>1 µS/cm up to 40 µS/cm	>250 µS/cm up to 100 mS/cm

pH MEASUREMENT

Measurement Range: pH 4 to 10 (standard); pH 0 to 14 (optional)

Sample Temperature Range: -23°F to 176°F (-5°C to 80°C)

Sensitivity: 0.01 pH

FLUORIDE MEASUREMENT

Measurement Range: 0.2 to 2.0 mg/l

Sample Temperature Range: 32°F to 176°F (0°C to 80°C)

Sensitivity: 0.01 mg/l fluoride

ELECTRONICS

Power Requirements: 115 V ±10%, 50/60 Hz, 14VA or 230 V ±10%, 50/60 Hz, 14VA

Ambient Temperature: 32°F to 122°F (0°C to 50°C)



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ELECTRONICS (CONT'D)

Enclosure Rating: NEMA 4X

Readout: 16-character, two-line, backlit LCD display

Output Signal: Isolated 4-20 mA for Disinfectant Residual, max. 1000 ohm load; (Optional) Isolated 4-20 mA for pH or fluoride, max. 1000 ohm load.

External Alarms: Two electromechanical relays, user configurable (high, low, high/low, gen. fault, or off) for chlorine. Selectable for N.O. or N.C. and latching or non-latching operation; (Optional) Two electromechanical relays, user configurable for pH or fluoride.

Relay Contact Ratings: 5A 1/6 HP 125, 250 VAC or 5A 30 VDC 30 Watt max.

Digital Input: One dry contact input for sample water or circulating pump monitoring.

Digital Communication: RS485 interface for connection to programmable controller or central instrumentation and control systems via RS485 USF/W&T protocol.

Access Code: A three-digit security code can be entered via the keypad to prevent unauthorized access to the operating parameters.

OPTIONAL ACCESSORIES

Flow Switch: Mounts on the inlet to the wetside. Provides alarm to electronic controls when there is a loss of sample to the wetside.



Stop Valve: Mounts on the inlet to the wetside or on the flow switch. Provides easy shut-off of the sample flow for maintenance and service.



Chart Recorders: Available as circular or strip chart type. Supplied with 400 24-hour or 100 7-day circular charts, or 24 Z-fold strip charts and one year's supply of fiber-tip pens. Available chart ranges: 0-0.2; 0-0.5; 0-1.00; 0-2.00; 0.5.00; 0-10.0; and 0-20.0.

Series A-790 Titrator: For chlorine measurement calibration. See TI 50.262 UA.

CO₂ Gas Reagent Kit: For use with the bare-electrode wetside for varying pH applications. Sample pressure must be greater than 1 bar but less than 4 bar with a temperature less than 32°C. The kit consists of a CO₂ regulator, relief valve and flowmeter assembly, CO₂ diffuser and tubing. Note that the CO₂ gas will not lower the pH of a sample with alkalinity (CaCO₃) above 250 mg/l.

Dimensions: See CN 150.560 to CN 150.562.

Shipping Weight:

- Membrane Wetside - 2.3 kg.
- Bare Electrode Wetside - 4.0 kg.
- Electronic Enclosure (single or dual input) - 3.6 kg.

OTHER RESIDUAL ANALYZERS AVAILABLE FROM USF/W&T

Micro/2000® Residual Analyzer: A high-accuracy, extremely reliable monitoring and control instrument for potable water, wastewater, and cooling water treatment. Suitable for measuring free and total chlorine, chlorine dioxide, and potassium permanganate residuals. See TI 50.505 UA.



Deox/2000® Dechlorination Analyzer: A precise instrument for accurately measuring both SO₂ and total chlorine residuals in wastewater effluent. See TI 50.515 UA.



Depolox® Basic Analyzer: A low-cost analyzer for monitoring free or total chlorine residuals in drinking water applications. Provides a 4-20 mA output signal for recording or remote alarm devices. See TI 50.565 UA.



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