

Free Chlorine Sensor

- MEASURE FREE CHLORINE without sample pretreatment. No messy and expensive reagents needed.
- AUTOMATIC CORRECTION to at least pH 9.5.
- EASILY REPLACEABLE MEMBRANE; no special tools required.
- AUTOMATIC COMPENSATION for changes in membrane permeability with temperature.
- AUTOMATIC PRESSURE EQUALIZATION maintains correct membrane tension.
- VARIOPOL CONNECTOR OPTION allows the sensor to be replaced without running new cable.



FEATURES AND APPLICATIONS

The Model 499ACL-01 sensor is intended for the continuous determination of free chlorine (hypochlorous acid plus hypochlorite ion) in water. The primary application is measuring chlorine in drinking water. The sensor requires no acid pretreatment and can measure free chlorine in samples having pH as high as 9.5. In some cases, samples having pH as great as 10.0 can be measured. For high pH applications, consult the factory. The linear range of the sensor is 0 to 10 ppm. For determination of higher levels of chlorine, consult the factory.

The 499ACL-01 is a membrane-covered amperometric sensor. The sensor consists of a hydrophilic membrane stretched tightly over a platinum cathode. A silver anode and an electrolyte solution complete the internal circuit. During operation, chlorine diffuses from the sample through the membrane. A polarizing voltage applied to the cathode completely reduces chlorine to chloride. The reduction produces a current, which the analyzer measures. The current is directly proportional to the rate at which chlorine diffuses through the membrane, which is ultimately proportional to the concentration of chlorine in the sample.

The 499ACL-01 sensor needs no pretreatment. Instead, the analyzer automatically applies a pH correction factor to

the chlorine reading. If the sample pH varies more than 0.2 pH (peak-to-peak), an auxiliary pH sensor is required to provide the continuous pH correction.

Because the rate of diffusion of free chlorine through the membrane depends on temperature, sensor response must be corrected for temperature changes. A Pt 100 RTD in the sensor measures the temperature, and the analyzer automatically performs the correction.

Stable, dilute chlorine standards do not exist, so the sensor must be calibrated against the results of a laboratory test run on a grab sample of the process liquid. Portable test kits are available from other manufacturers.

All amperometric free chlorine sensors respond to changes in pH. Although free chlorine is a mixture of hypochlorous acid and hypochlorite ion, hypochlorous acid alone is responsible for the sensor current. Because the relative amounts of hypochlorous acid and hypochlorite depend on pH, a pH change will cause the current and the apparent free chlorine concentration to change, even though the true concentration remained constant. To compensate for variable pH, most competing sensors require the sample to be treated with acid. Acid converts the free chlorine completely to hypochlorous acid, and eliminates the interference.

FEATURES AND APPLICATIONS

Maintenance is fast and easy. Replacing the membrane requires no special tools or fixtures. Simply place a few drops of electrolyte solution in the membrane assembly, place it on the cathode and screw the retainer in place. To replenish the electrolyte solution, unscrew the fill plug, add the reagent from a squeeze bottle, and replace the plug.

Pressure changes have little influence on sensor response. A flexible bladder in the sensor prevents distortion

of the membrane by keeping the pressure inside the sensor equal to the sample pressure.

The Model 499ACL-01 sensor is available with a Variopol (VP) watertight connector. Wire the interconnecting cable to the analyzer and run the cable to the sensor. The sensor plugs into the cable receptacle. To replace the sensor, simply disconnect the Variopol fitting and plug in a new sensor.

SENSOR SPECIFICATIONS

Range: 0 to 10 ppm (mg/L) as Cl₂. For higher ranges, consult the factory.

Wetted Parts: Noryl¹, Viton², silicone, platinum, and polyethersulfone.

Accuracy: Accuracy depends on the accuracy of the chemical test used to calibrate the sensor.

pH range: 6.0 to 9.5. For samples having pH between 9.5 and 10.0, consult the factory. Samples with pH below 6.0 require no pH correction.

pH correction: Use continuous pH correction (requires an auxiliary pH sensor) if sample pH varies more than 0.2 pH (peak-to-peak). If pH variability is less or seasonal, the pH sensor is generally not required.

Interferences: peroxides, permanganate, chloramines.

Sample conductivity: >50 µS/cm.

Response time: 22 sec to 95% of final reading at 25°C

Pressure: 0 to 65 psig (0 to 549 kPa abs)

Temperature: 32 to 122°F (0 to 50°C)

Sample Flow:

Flow through	1-5 gpm (3.8 to 19 L/min)
Open channel	1 ft/sec (0.3 m/sec)
Low flow cell (PN 24091-00)	8 to 15 gph (30 to 57 L/hr)
Low flow cell (PN 24091-01)	2 to 5 gph (8 to 19 L/hr)

Process Connection: 1 inch MNPT

Electrolyte Volume: 25 mL (approx.)

Electrolyte Life: 3 months (approx.); for best results, replace electrolyte monthly

Cable Length (standard integral cable): 25 ft (7.6 m)

Cable Length (maximum): 300 ft (91 m)

Weight/Shipping Weight: 1 lb/3 lb (0.5 kg/1.5 kg)

¹ Noryl is a registered trademark of General Electric.

² Viton is a registered trademark of E.I. duPont de Nemours & Co.

OTHER SPECIFICATIONS

LOW FLOW CELL PN 24091-00 and 24091-01.

PN 24091-01 contains a bubble sweeping nozzle to keep bubbles from accumulating against the membrane. It is intended for samples where high flows are not available. See flow specifications above.

Wetted Parts: polycarbonate, polyester, 316 stainless steel, silicone

Process Connection: 1/4-inch OD tubing compression fitting or 1/4-inch FNPT

Maximum Pressure: 90 psig (722 kPa abs)

Maximum Temperature: 158°F (70°C)

Note: The temperature and pressure specifications for the low flow cell exceed the specifications for the sensor.

FLOW-THROUGH TEE (1-1/2 inch body) PN 23567-00

Wetted Parts: CPVC and Buna N; body is schedule 80 CPVC

Process Connection: 1-1/2 inch socket

Maximum Pressure: 65 psig (549 kPa abs)

Maximum Temperature: 122°F (50°C)

FLOW-THROUGH TEE (2 in. body) PN 915240-03, 04, 05

Wetted Parts: PVC and Buna N; body is schedule 80 PVC

Process Connection: 3/4 inch NFPT, 1 inch NFPT, or 1-1/2 inch NFPT

Maximum Pressure: 60 psig (515 kPa abs)

Maximum Temperature: 120°F (49°C)

VALVED ROTAMETER PN 196-898754
for use with **Low Flow Cell PN 24091-00**

Flow: 2 to 20 gph (7.6 to 76 L/hr)

Wetted Parts: polycarbonate, 316 stainless steel, brass, Buna N

Process Connection: 1/8 inch NFPT (brass)

Maximum Pressure: 100 psig (858 kPa abs)

Maximum Temperature: 130°F (54°C)

VALVED ROTAMETER PN 9390004
for use with **Low Flow Cell PN 24091-01**

Flow: 0.4 to 5 gph (1.5 to 19 L/hr)

Wetted Parts: acrylic, 316 stainless steel, Viton

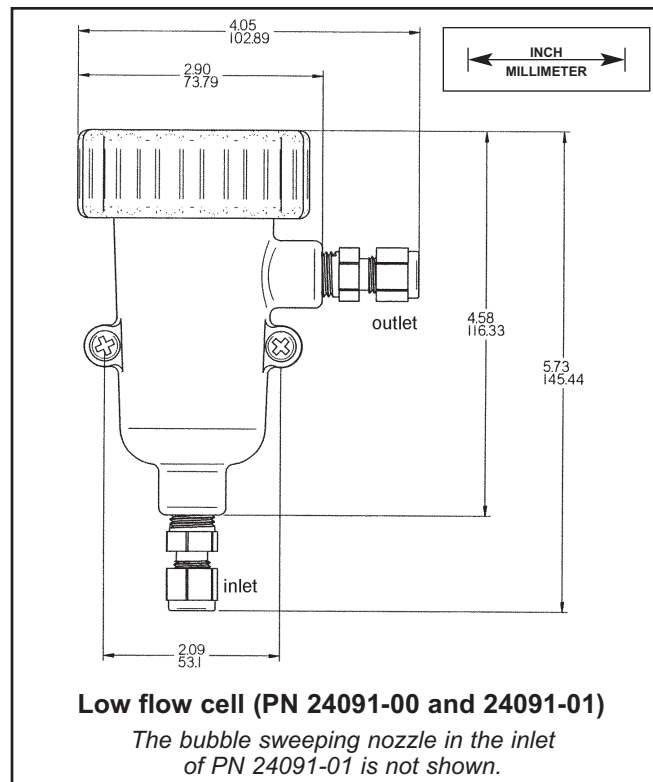
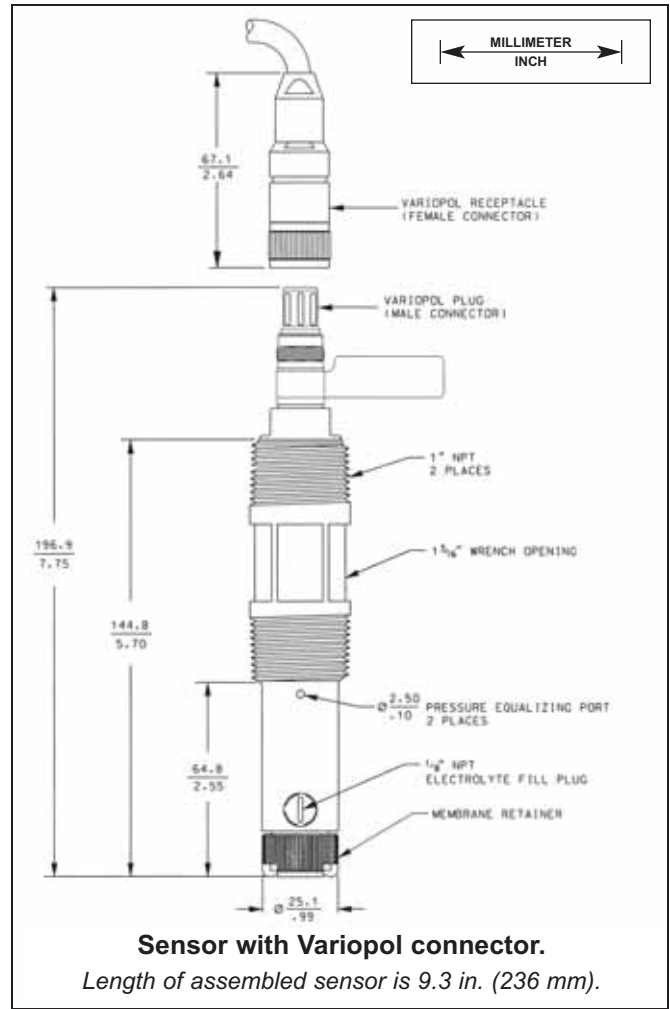
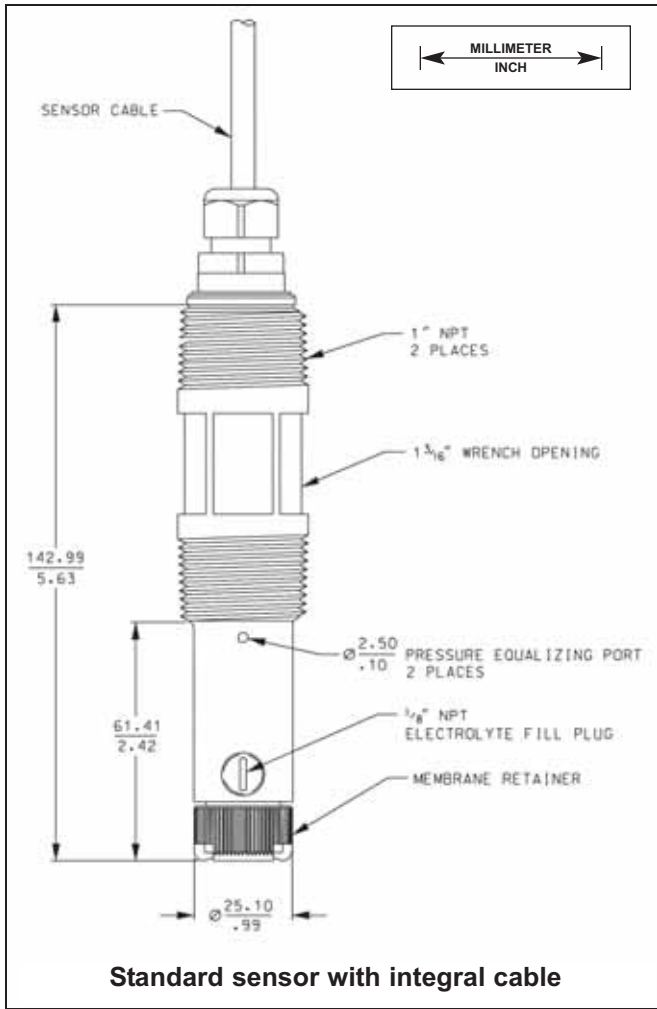
Process Connection: 1/4-inch NFPT (316 SS)

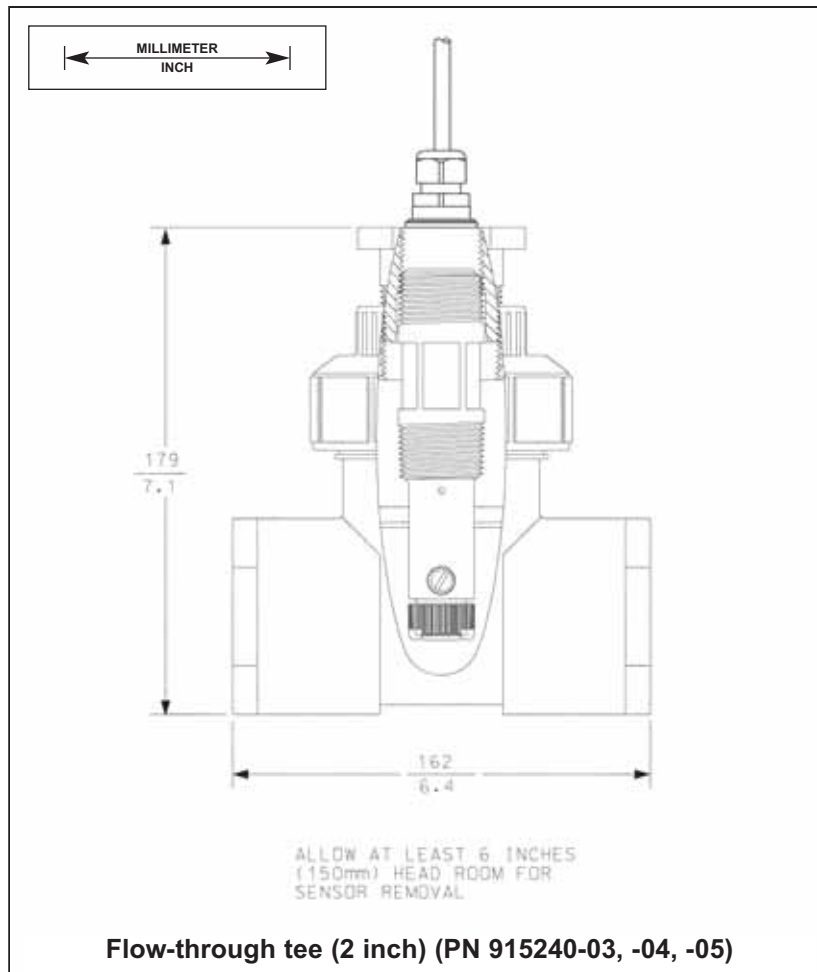
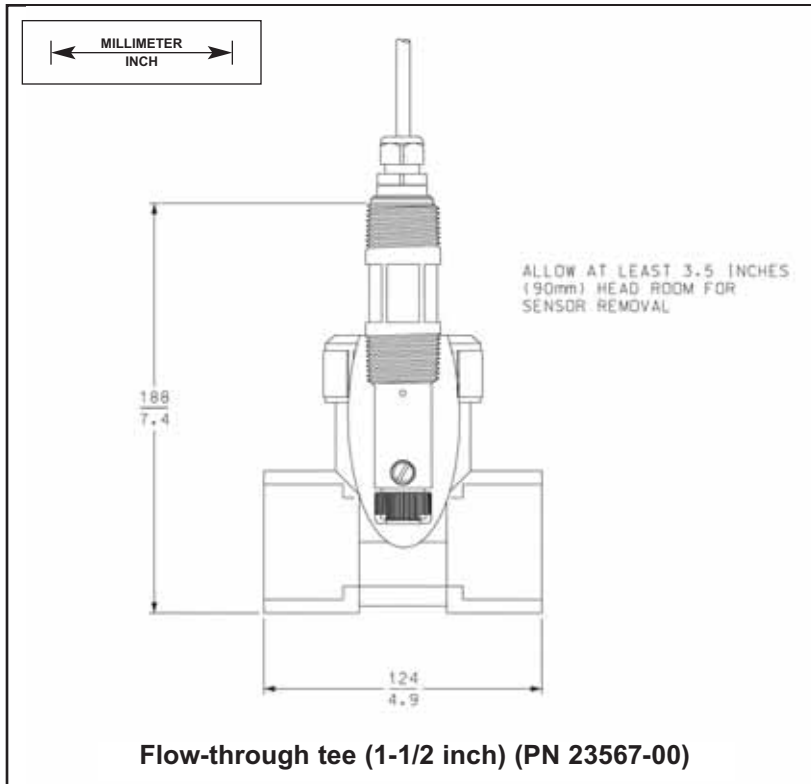
Maximum Pressure: 100 psig (858 kPa abs)

Maximum Temperature: 150°F (65°C)

RECOMMENDED ANALYZERS

Use the 499ACL-01 with Models 1056, 56, 54eA, 5081-A, 1066, and Xmt-A.





ORDERING INFORMATION

The **Model 499ACL-01 sensor** is intended for the determination of free chlorine in water. The sensor is generally intended for mounting in a flow cell installed in a sidestream sample. The sensor is available with either an integral cable or a VP 6.0 quick disconnect fitting. Three replacement membrane assemblies, three o-rings and a 4-oz (125 mL) bottle of electrolyte solution are provided with each sensor.

MODEL 499ACL-01 FREE CHLORINE SENSOR	
CODE	Required selection
54	For use with Model 1056, 56, 54e A, 5081-A, 1066, and Xmt-A analyzers
CODE	Optional selection
60	Optimum EMI/RFI cable (not available with -VP option)
VP	Sensor with Variopol 6 connector (interconnecting cable must be ordered separately)
499ACL-01 -54 -VP EXAMPLE	

FOR FIRST TIME VARIOPOL INSTALLATIONS

PART #	DESCRIPTION
23747-06	Interconnecting cable, VP 6, 2.5 ft (0.8 m)
23747-04	Interconnecting cable, VP 6, 4 ft (1.2m)
23747-02	Interconnecting cable, VP 6, 10 ft (3.0 m)
23747-07	Interconnecting cable, VP 6, 15 ft (4.6 m)
23747-08	Interconnecting cable, VP 6, 20 ft (6.1 m)
23747-09	Interconnecting cable, VP 6, 25 ft (7.6 m)
23747-10	Interconnecting cable, VP 6, 30 ft (9.1 m)
23747-03	Interconnecting cable, VP 6, 50 ft (15.2 m)
23747-11	Interconnecting cable, VP 6, 100 ft (30.5 m)

ACCESSORIES

PART #	DESCRIPTION
23567-00	1-1/2 in. flow through tee with 1-1/2 socket connections
914240-03	2-in. flow through tee with 3/4-in FNPT connections
915240-04	2-in. flow through tee with 1-in FNPT connections
915240-05	2-in. flow through tee with 1-1/2-in FNPT connections
24091-00	Low flow cell for 8 - 15 gph
24091-01	Low flow cell with bubble sweeping nozzle for 2 - 5 gph
196-898754	Rotameter: 2.0 - 20.0 gph
23550-00	Junction box, 12 terminals
9200266	Extension cable (standard), unterminated (specify length)
9200275	Extension cable (optimum EMI/RFI), unterminated (specify length)
23747-00	Extension cable (optimum EMI/RFI), terminated (specify length)
2001492	Stainless steel tag
23501-08	Free chlorine membrane assembly: includes one membrane assembly and O-ring.
23502-08	Free chlorine membrane assembly: includes three membrane assemblies and three O-rings.
9210356	#4 Free chlorine sensor fill solution, 4 oz (125 mL)

RECOMMENDED pH SENSORS

MODEL	DESCRIPTION
3900-02-10	3900 sensor with 15 ft (4.7 m) cable, no pre-amplifier
3900-01-10	3900 sensor with 32 ft (10 m) cable, with integral preamplifier
3900VP-02-10	3900 sensor with VP connector (consult 3900/3900VP product data sheet for cable).

MODEL 499ACL-01 ENGINEERING SPECIFICATION

1. The sensor shall be suitable for the determination of free chlorine in water without the use of sample conditioning reagents. Sensors that require sample conditioning are not acceptable.
2. The sensor shall be suitable for use in samples having pH as high as 9.5.
3. An auxiliary pH sensor to compensate for the effect of pH on the chlorine sensor response shall be required if the pH variability is more than 0.2 units (peak-to-peak). Otherwise, a pH sensor shall not be required.
4. The sensor shall be a two-electrode membrane-covered sensor with a silver/silver chloride anode and a platinum cathode. The fill solution shall be potassium chloride.
5. The sensor shall have a 1-inch MNPT process connection.
6. The sensor shall be able to tolerate temperature between 32 and 122°F (0 to 50°C) and a pressure as high as 65 psig (549 kPa abs).
7. Flow cells designed for the sensor shall be available. A low flow cell requiring no more than about 2 gal/hour (8 L/hr) of sample shall be available.
8. The response time to a step change in free chlorine concentration shall be about 22 seconds to 95% of final value.
9. Sensor maintenance shall require no special tools or fixtures.
10. The sensor fill solution shall require replacing no more often than once a month.
11. The sensor shall be available with either integral cable or a VP 6 quick disconnect fitting.
12. The sensor shall be Rosemount Analytical Model 499ACL-01-54 (standard integral cable), 499ACL-01-54-60 (optimum EMI/RFI resistant cable), 499ACL-01-54-VP (VP 6 connection), or approved equivalent.

COMPATIBLE ANALYZERS AND TRANSMITTERS

The Model 1056 Dual Input Analyzer

offers the choice of single or dual sensor inputs in any combination of pH/ORP, contacting and toroidal conductivity (or resistivity), chlorine, oxygen, and ozone. When used with the 499ACL-01 sensor, the most common dual-channel configuration is chlorine and pH, where the pH measurement is used to compensate the chlorine reading for pH effects. The Model 1056 analyzer features a large, easy to read back lit display, which can be customized to fit user requirements. The analyzer has two fully programmable analog outputs, and digital communication, either HART or Profibus DP, is available as an option. Four fully programmable alarm relays are also optional. Diagnostic variables to aid in troubleshooting are displayed at the touch of a button. Menu prompts can be displayed in one of seven user-selectable languages. Programming and calibrating is so simple that a manual is almost not necessary.



The Model 56 Dual Input Analyzer

offers the choice of single or dual sensor inputs in any combination of pH/ORP, contacting or toroidal conductivity, chlorine, oxygen, or ozone. When used with the 499ACL-01 sensor, the most common dual-channel configuration is chlorine and pH, where the pH measurement is used to compensate the chlorine reading for pH effects. The analyzer has four fully programmable analog outputs and four fully programmable alarm relays, including PID and TPC control. The high contrast, full color display shows measurement results in large, easy-to-read digits. Menu screens for programming and calibration are simply and intuitive. Information screens, offering detailed explanation of programming features and calibration methods as well as troubleshooting assistance, are available at the touch of a button. An event and data logger and a dual graphical display are also standard. HART and Profibus DP digital communication are optional.



The Model 5081 Conductivity Transmitter

is compatible with any Rosemount Analytical amperometric sensor (chlorine, oxygen, or ozone). Although the 5081-A is a single input and single output device, a second input channel for pH is available if the instrument is configured to measure free chlorine. The pH channel is used to correct the chlorine reading for pH effects. The analog output is dedicated to chlorine, but it can be freely scaled to any range. Two digital communication protocols, HART and Foundation Fieldbus, are available as options. The 5081-A has a large, easy to read display. Local communication with the transmitter is through an infrared remote controller. The analyzer enclosure is NEMA 7B (explosion-proof).



The Model Xmt-A Transmitter

is compatible with any Rosemount Analytical amperometric sensor (chlorine, oxygen, or ozone). Although the Xmt-A is a single input and single output device, a second input channel for pH is available if the instrument is configured to measure free chlorine. The pH channel is used to correct the chlorine reading for variability caused by pH changes. The analog output is dedicated to chlorine, but it can be freely scaled to any range. Two digital communication protocols, HART and Foundation Fieldbus, are also available as options. The local display has two lines and can be customized to fit user requirements. Menu prompts (in six user-selectable languages) for calibrating and programming are clear and intuitive.



FREE CHLORINE MEASUREMENT SYSTEM

Instead of ordering and assembling individual components, choose the Model FCL Free Chlorine System. The Model FCL consists of the free chlorine sensor, a pH sensor (if required), the analyzer, VP quick-disconnect cable(s) prewired to the analyzer, flow cell(s), and a constant head flow controller. The flow controller automatically provides the correct sample flow and eliminates the need for pressure regulators, valves, and rotameters. Commissioning the FCL is simple. The analyzer, flow controller, and flow cells are all mounted on a back plate. Simply mount the FCL on a wall, bring in power and sample, provide a drain, and connect the sensors to the cables.





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