Instruction Manual
PN 51-TCL-1056/rev.D
May 2011

Model TCL

Total Chlorine Analyzer

ROSEMOUNT®
Analytical

EMERSON™
Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, telephone 1-800-654-7768 and the requested manual will be provided. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

WARNING

ELECTRICAL SHOCK HAZARD

Making cable connections to and servicing this instrument require access to shock hazard level voltages which can cause death or serious injury.

Be sure to disconnect all hazardous voltage before opening the enclosure.

Relay contacts made to separate power sources must be disconnected before servicing.

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.

Unused cable conduit entries must be securely sealed by non-flammable closures to provide enclosure integrity in compliance with personal safety and environmental protection requirements.

The unused conduit openings need to be sealed with NEMA 4X or IP65 conduit plugs to maintain the ingress protection rating (IP65).

For safety and proper performance this instrument must be connected to a properly grounded three-wire power source.

Proper relay use and configuration is the responsibility of the user.

No external connection to the instrument of more than 69VDC or 43V peak allowed with the exception of power and relay terminals. Any violation will impair the safety protection provided

Do not operate this instrument without front cover secured. Refer installation, operation and servicing to qualified personnel.

WARNING

This product is not intended for use in the light industrial, residential or commercial environment, per the instrument's certification to EN50081-2.

Emerson Process Management

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WARNING

HAZARDOUS VOLTAGE

Can cause severe injury or death. Disconnect power before servicing.

VYSTRAHA

NEBEZPECNE NAPETI

Muze zpusobit vazne zraneni nebo smrt. Odpojte napajeni pred udrzbou.

AVISO

VOLTAJE PELIGROSO

Puede causar severas lesiones o muerte. Desconecte la alimentación antes del mantenimiento.

ADVARSEL

FARLIG SPÆNDING

Kan forårsage alvorlige kvæstelser eller død.

Afbryd spænding før servicering.

ATTENTION

HAUTE TENSION

Peut provoquer des blessures graves ou la mort. Déconnecter l'alimentation avant manipulation.

OSTRZEZENIE

NIEBEZPIECZNE NAPIECIE

Moze spowodowac uszkodzenie ciala lub smierc.Odlacz zasilanie przed przystapieniem do prac.

WARNUNG

GEFAEHRLICHE SPANNUNG

Am Geraet liegt eine gefaehrliche Spannung an. Schalten Sie immer vor dem Oeffnen des Geraetes alle Zuleitungen spannungsfrei.

Waarschuwing

GEVAARLIJKE SPANNING

Kan ernstig of dodelijk letsel veroorzaken. Schakel de voeding uit voordat u onderhoudswer kzaamheden uitvoert.

Attenzione

ALTA TENSIONE

Può causare grave lesione o morte. Disattivare le tensioni prima di effettuare la manutenzione.

ADVARSEL

FARLIG SPENNING

Kan føre til alvorlige skader eller dødsulykker. Spenningstilførsel må frakobles før service utføres.

VARNING

LIVSFARLIG SPÄNNING

Kan medföra allvarlig skada eller dödsfall.

Bryt spänning innan service utföres.

AVISO

TENSÃO PERIGOSA

Pode causar lesões graves ou a morte. Desligar a energia antes de proceder a trabalhos de manutenção.

DANGER

HAZARDOUS AREA INSTALLATION

Installations near flammable liquids or in hazardous area locations must be carefully evaluated by qualified on site safety personnel. This device is not Intrinsically Safe or Explosion Proof.

To secure and maintain an intrinsically safe installation, the certified safety barrier, transmitter, and sensor combination must be used. The installation system must comply with the governing approval agency (FM, CSA or BASEEFA/CENELEC) hazardous area classification requirements. Consult your analyzer/transmitter instruction manual for details.

Proper installation, operation and servicing of this device in a Hazardous Area Installation is entirely the responsibility of the user.

CAUTION

SENSOR/PROCESS APPLICATION COMPATIBILITY

Wetted materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.

About This Document

This manual contains instructions for installation and operation of the Model TCL1056 Total Chlorine Analyzer.

The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
A	7/07	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering.
B	11/07	Page 3 additions to 1.3 Specifications, page 5 changes to the Analyzer (option selection) table, page 14 updated the caution box and page 15 updated section 4.3.3.
C	7/10	Updated DNV logo.
D	5/11	Revised Sec. 1, specs 1.3, replaced fig 3-3, revised sec. 4.3.3 wiring, replaced fig 4.4. add to digital communication sec 8.0, revise sec. 11.6.

MODEL TCL
TOTAL CHLORINE ANALYZER

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SECTION 1.
DESCRIPTION AND SPECIFICATIONS

Model TCL Sample Conditioning System

- **NO METAL WETTED PARTS.** Ideal for seawater.
- **LOW SAMPLE FLOW** (about 15 mL/minute) means little waste.
- **REAGENT-BASED SYSTEM** measures true total chlorine.
- **FIVE GALLONS OF REAGENT** lasts two months.

Model 1056 Chlorine Analyzer

- **LARGE, PROGRAMMABLE, BACK-LIT DISPLAY** with easy to use interface.
- **TWO INDEPENDENT ANALOG OUTPUTS.**
- **FOUR FULLY PROGRAMMABLE RELAYS** optional.
- **DIGITAL COMMUNICATIONS (HART OR PROFIBUS DP)** optional.

Model 499A CL-02 Sensor

- **MEMBRANE-COVERED AMPEROMETRIC SENSOR**.
- **NO TOOLS REQUIRED** to change membrane.
- **MAINTENANCE TAKES ONLY A FEW MINUTES** a month.
- **VARIOPOL CONNECTOR OPTION** allows the sensor to be replaced without removing and rewiring cable.

1.1 FEATURES

MODEL TCL SAMPLE CONDITIONING SYSTEM

The sample conditioning system permits a single sensor to measure total chlorine in water. The sample conditioning system continuously injects a solution of acetic acid (vinegar) and potassium iodide into the sample. The acid lowers the pH to between 3.5 and 4.5 and allows total chlorine in the sample to quantitatively react with the potassium iodide to produce iodine. The sensor measures the iodine concentration, and the analyzer displays the total oxidant concentration in ppm as Cl_2.

MODEL 1056 CHLORINE ANALYZER

The Model 1056-24 chlorine analyzer is designed for the continuous determination of chlorine in water. It is used with the Model 499ACL-02 sensor and TCL sample conditioning system.

The Model 1056 analyzer is housed in a weatherproof, corrosion-resistant, NEMA 4X enclosure. It is suitable for wall, panel, or pipe mounting. Operation of the analyzer is through a membrane keypad. A back-lit, six line display shows the total chlorine reading and temperature in 0.6 inch (15 mm) high characters. The display can be customized to show other information, for example, output signal and diagnostics.

Menu screens for calibrating and programming are simple an intuitive. Plain language prompts in six languages guide the user through procedures. Information and diagnostic screens as well as basic trouble-shooting guidelines are available at the touch of a button.

The Model 1056 has two isolated, continuously variable 4-20 mA outputs. Outputs can be assigned to total chlorine concentration or to temperature. Digital communications, HART or Profibus DP, are available as options.

Four fully programmable alarm relays are available as an option. Relays can be assigned to total chlorine concentration or temperature. A relay can also be used to signal a fault condition. A fault alarm activates when an analyzer or sensor fault occurs.

When used for the determination of total chlorine, the Model 1056 analyzer is a single input instrument. The analyzer is also available in a dual input version, where the second input can be pH, conductivity, dissolved oxygen, chlorine, or turbidity. For more information about the dual input option, refer to product data sheet PDS 71-1056.

MODEL 499A CL-02 SENSOR

The Model 499ACL-02 total chlorine sensor is used in the TCL sample conditioning system. Although the sensor is called a chlorine sensor, it really measures iodine. The iodine comes from the reaction between oxidants in the sample and the acetic acid/potassium iodide reagent added by the sample conditioning system.

The sensor consists of a gold cathode and a silver anode in an electrolyte solution. A silicone membrane, permeable to iodine, is stretched over the cathode. The analyzer applies a voltage to the cathode sufficiently negative to reduce all the iodine reaching it. Because the concentration of iodine in the sensor is always zero, a concentration gradient continuously forces iodine from the sample through the membrane into the sensor.

The reduction of iodine in the sensor generates a current directly proportional to the diffusion rate of iodine through the membrane, which is directly proportional to the concentration of iodine in the sample. Because the iodine concentration depends on the amount of total chlorine in the sample, the sensor current is ultimately proportional to the total chlorine concentration.

The permeability of the membrane to iodine is a function of temperature. A Pt100 RTD in the sensor measures the temperature, and the analyzer uses the temperature to compensate the total chlorine reading for changes in membrane permeability.

Sensor maintenance is fast and easy. Replacing the membrane requires no special tools or fixtures. Simply place the membrane assembly on the cathode and screw the retainer in place. Installing a new membrane and replenishing the electrolyte takes only a few minutes.

1.2 SPECIFICATIONS — SAMPLE CONDITIONING SYSTEM

GENERAL

Enclosure: Fiberglass reinforced polyester, NEMA 3 (IP53) suitable for marine environments

Dimensions: 14.5 x 13.0 x 8.6 in. (369 x 329 x 218 mm)

Mounting: Wall

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

Ambient Humidity: 0 - 90% (non-condensing)

Power: 115 Vac, 6.9 W, 50/60 Hz;
230 Vac, 7.0 W, 50/60 Hz

Hazardous Location: The TCL sample conditioning system has no hazardous location approvals.

Pumps:
EN 809:1998 CE

Weight/Shipping Weight: 14 lb/16 lb (6.5 kg/7.5 kg)

SAMPLE REQUIREMENTS

Inlet Connection: compression fitting, accepts 1/4 in. OD tubing

Drain Connection: 3/4 in. barbed fitting (must drain to open atmosphere)

Inlet Pressure: <100 psig (791 kPa abs)

Flow: at least 0.25 gph (15 mL/min)

Temperature: 32 - 122°F (0 - 50°C)

Total Alkalinity: <300 mg/L as $CaCO_3$. For samples containing <50 mg/L alkalinity, consult the factory.

SAMPLE CONDITIONING SYSTEM

Reagent: Potassium iodide in vinegar.

Reagent Usage: 5 gallons lasts approximately 60 days.

Reagent Pump: Fixed speed peristaltic pump, about 0.2 mL/min

Sample Pump: Fixed speed peristaltic pump, about 11 mL/min

1.3 SPECIFICATIONS — MODEL 1056 ANALYZER

Case: Polycarbonate NEMA 4X/CSA 4 (IP65).

Dimensions: 6.10 x 6.10 x 5.15 in. (155 x 155 x 131 mm)

Conduit openings: Accepts PG13.5 or 1/2 in. conduit fittings

Display: Monochromatic back-lit LCD. Main character height 0.6 in (15mm). Display is user-programable

Languages: English, German, Italian, Spanish, French, Portuguese

Ambient temperature and humidity: 32 to 131°F (0 to 55°C); RH 5 to 95% (con-condensing)

Storage temperature: -4 to 140°F (-20°C and 60°C)

Power: Code -01: 115/230 VAC ±15%, 50/60 Hz. 10 W.
Code -03: 85 to 265 VAC, 47.5 to 65.0 Hz, 15 W (includes four relays)

☐ Equipment protected by double insulation

Hazardous Location Approvals - Applies to analyzer only.

LR 34186
C US

Class I, Division 2, Groups A, B, C, & D
Class II, Division 2, Groups E, F, & D
Class III T4 Tamb= 50°C

Evaluated to the ANSI/UL Standards. The 'C' and 'US' indicators adjacent to the CSA Mark signify that the product has been evaluated to the applicable CSA and ANSI/UL Standards, for use in Canada and the U.S. respectively

RFI/EMI: EN-61326
LVD: EN-61010-1 CE

Outputs: Two 4-20 mA or 0-20 mA isolated outputs. Continuously adjustable. Linear or logarithmic. Maximum load 550 ohms. Output dampening with time constant of 5 sec is user-selectable.

Alarms relays (analyzer option -03 only): Four alarm relays for process measurement(s) or temperature. Any relay can be configured as a fault alarm instead of a process alarm. Each relay can be configured independently and each can be programmed with interval timer settings.

Relays: Form C, SPDT, epoxy sealed

Relay Contact ratings:
5 A at 28 VDC or 300 VAC (resistive)
1/8 HP at 120/240 VAC.

Terminal Connections Rating: Power connector (3-leads): 18-12 AWG wire size. Current output connectors (2-leads): 24-16 AWG wire size. Alarm relay terminal blocks: 18-16 AWG wire size

Weight/Shipping Weight: (rounded up to nearest lb or nearest 0.5 kg): 1.5 kg (3 lb)/2.0 kg (4 lb)

1.4 SPECIFICATIONS — MODEL 499ACL-02 SENSOR

Wetted Parts: Gold, Noryl®[1] (PPO), Viton®[2], EPDM, Silicone

Dimensions: 1.0 x 5.6 in. (25.4 x 143 mm)

Cable: 25 ft. (7.6m) standard

Pressure Rating: 0 to 65 psig (101 to 549 kPa)

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

Electrolyte Capacity: Approximately 25 mL

Electrolyte Life: Approximately 4 months

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 DuPont Performance Elastomers.

1.5 PERFORMANCE SPECIFICATIONS — COMPLETE SYSTEM

Linear Range: 0 to 20 ppm (mg/L) as Cl_2 (for higher ranges, consult factory)

Linearity (per ISO 15839): 0-10 ppm: 2%; 0-20 ppm: 3%

Response Time: Following a step change in concentration, the reading reaches 90% of final value within 7 minutes at 25°C.

Drift: At about 1.5 ppm in clean water and constant temperature, drift is typically less 0.05 ppm over two weeks.

Detection Limit (per ISO 15839): 0.02 ppm (mg/L) in clean water at room temperature

1.6 ORDERING INFORMATION AND ACCESSORIES

Model TCL Reagent-Based Chlorine System. The TCL is used for the continuous determination of total chlorine in water. The TCL consists of a sample conditioning system, a reagent carboy, a sensor, and an analyzer. **Reagents must be ordered separately. Regent kits for 0-5 ppm and 0-10 ppm chlorine are available. For higher ranges, consult the factory.** See **ACCESSORIES - Sample Conditioning System**.

MODEL TCL	REAGENT-BASED CHLORINE SYSTEM
CODE	**POWER (required selection)**
11	115 V 50/60 Hz
12	230 V 50/60 Hz

CODE	ANALYZER (optional selection)
270	1056-01-24-38-AN analyzer, no alarm relays, analog outputs
271	1056-01-24-38-HT analyzer, no alarm relays, HART
272	1056-01-24-38-DP analyzer, no alarm relays, Profibus DP
273	1056-03-24-38-AN analyzer, with alarm relays, analog outputs
274	1056-03-24-38-HT analyzer, with alarm relays, HART
275	1056-03-24-38-DP analyzer, with alarm relays, Profibus DP

CODE	SENSOR (optional selection)
30	499ACL-02-54 sensor with standard cable
31	499ACL-02-54-60 sensor with optimum EMI/RFI cable
32	499ACL-02-54-VP sensor with Variopol 6.0 fitting (interconnecting cable must be ordered separately)

ACCESSORIES — SAMPLE CONDITIONING SYSTEM

PN	Description	Weight*	Ship Weight**
24134-00	Air pump, 115 Vac, 50/60 Hz	1 lb (0.5 kg)	1 lb (0.5 kg)
24134-01	Air pump, 230 Vac, 50/60 Hz	1 lb (0.5 kg)	1 lb (0.5 kg)
9160578	Air pump repair kit	1 lb (0.5 kg)	1 lb (0.5 kg)
9322052	Check valve for air injection line	1 lb (0.5 kg)	1 lb (0.5 kg)
24153-00	Carboy for reagent, 5 gal/19 L, includes cap	4 lb (1.5 kg)	5 lb (2.0 kg)
9100204	Fuse, 0.25 A, 250 V, 3AG, slow blow for option -11 (115 Vac)	1 lb (0.5 kg)	1 lb (0.5 kg)
9100132	Fuse, 0.125 A, 250 V, 3AG, slow blow for option -12 (230 Vac)	1 lb (0.5 kg)	1 lb (0.5 kg)
9380094	Reagent pump, 115 Vac, 50/60 Hz	1 lb (0.5 kg)	2 lb (1 kg)
9380095	Reagent pump, 230 Vac, 50/60 Hz	1 lb (0.5 kg)	2 lb (1 kg)
9380091	Reagent pump replacement tubing	1 lb (0.5 kg)	2 lb (1 kg)
24151-00	Reagent tubing replacement kit	1 lb (0.5 kg)	2 lb (1 kg)
24135-00	Reagent uptake tubing, 6 ft (1.8 m), includes weight	1 lb (0.5 kg)	2 lb (1 kg)
9380090	Sample pump, 115 Vac, 50/60 Hz	1 lb (0.5 kg)	2 lb (1 kg)
9380093	Sample pump, 230 Vac, 50/60 Hz	1 lb (0.5 kg)	2 lb (1 kg)
9380092	Sample pump replacement tubing	1 lb (0.5 kg)	2 lb (1 kg)
24152-00	Sample tubing replacement kit	1 lb (0.5 kg)	2 lb (1 kg)

PN	Description	Weight*	Ship Weight**
24165-00	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 25 g potassium iodide (0-5 ppm total chlorine)	45 lb (20.5 kg)	48 lb (22.0 kg)
24165-01	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 50 g potassium iodide (0-10 ppm total chlorine)	45 lb (20.5 kg)	48 lb (22.0 kg)
24164-00	Potassium iodide, 25 g, sufficient for 5 gallons (19 L) of vinegar (0-5 ppm total chlorine)	1 lb (0.5 kg)	1 lb (0.5 kg)
24164-01	Potassium iodide, 50 g, sufficient for 5 gallons (19 L) of vinegar (0-10 ppm total chlorine)	1 lb (0.5 kg)	1 lb (0.5 kg)

*Weights are rounded up to the nearest whole pound or 0.5 kg.

ACCESSORIES — 1055-24 Analyzer

PN	DESCRIPTION	WEIGHT*	SHIP WEIGHT*
9240048-00	Tag, stainless steel, specify marking	1 lb (0.5 kg)	1 lb (0.5 kg)
23820-00	Pipe mounting kit	2 lb (1.0 kg)	3 lb (1.5 kg)

ACCESSORIES — 54eA Analyzer

PN	DESCRIPTION	WEIGHT*	SHIP WEIGHT*
2002577	Wall and two inch pipe mounting kit	2 lb (1.0 kg)	3 lb (1.5 kg)
23545-00	Panel mounting kit	2 lb (1.0 kg)	3 lb (1.5 kg)
23554-00	Cable glands, kit (Qty 5 of PG 13.5)	1 lb (0.5 kg)	1 lb (0.5 kg)
9240048-00	Stainless steel tag (specify marking)	1 lb (0.5 kg)	1 lb (0.5 kg)

ACCESSORIES — Sensor

PN	DESCRIPTION	WEIGHT*	SHIP WEIGHT*
23501-02	Total Chlorine Membrane, includes one membrane assembly and one O-ring	1 lb (0.5 kg)	1 lb (0.5 kg)
23502-02	Total Chlorine Membrane Kit, includes 3 membrane assemblies and three O-rings	1 lb (0.5 kg)	1 lb (0.5 kg)
9210438	Total Chlorine Sensor Fill Solution, 4 oz (120 mL)	1 lb (0.5 kg)	2 lb (1.0 kg)

*Weights are rounded up to the nearest whole pound or 0.5 kg.

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)

SECTION 2. PRINCIPLES OF OPERATION

Total chlorine by definition is the iodine produced in a sample when it is treated with potassium iodide at a pH between 3.5 and 4.5. Typically, acetic acid (or vinegar) is used to adjust the pH.

The total chlorine analyzer consists of a sample conditioning system, which injects the reagent into the sample, and a sensor and analyzer, which measure the amount of iodine produced. Figure 2-1 shows the sample conditioning system. The sample enters the sample conditioning enclosure and flows to an overflow sampler from which the sample pump takes suction. Excess sample drains to waste. At the same time, the reagent pump draws reagent, a solution of potassium iodide in vinegar, from the reagent carboy and injects it into the suction side of the sample pump. The sample and reagent mix as they pass through the pump, and total chlorine in the sample is converted to the chemically equivalent amount of iodine. The flow rates are 11 mL/min for the sample and 0.2 mL/min for the reagent.

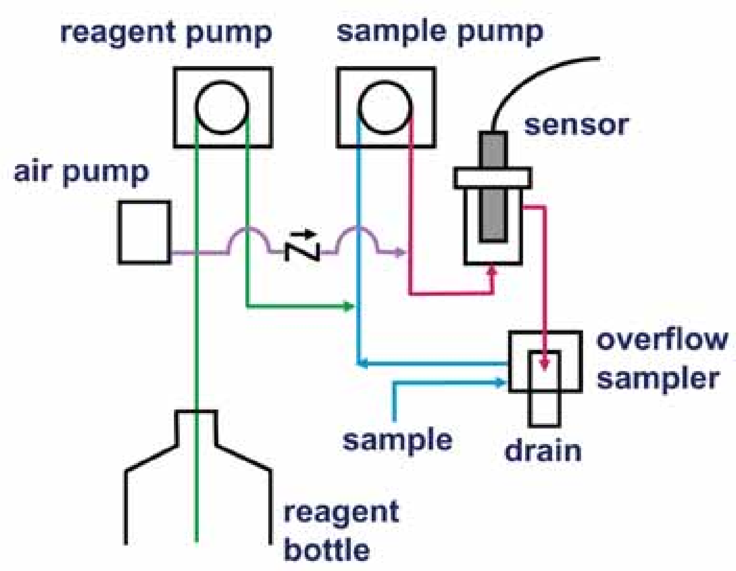


FIGURE 2-1. Schematic of Sample Conditioning System and Analyzer.

The treated sample next enters the flow cell. Bubbles injected into the flow cell produce turbulence, which improves the stability of the reading. A membrane-covered amperometric sensor in the flow cell measures the concentration of iodine. The analyzer receives the raw signal from the sensor and displays the concentration of total chlorine. Display units are ppm (mg/L) chlorine as Cl_2. The treated sample leaves the flow cell and drains to waste along with the excess sample.

SECTION 3. INSTALLATION

3.1 UNPACKING AND INSPECTION

Inspect the shipping containers. If there is damage, contact the shipper immediately for instructions. Save the boxes. If there is no apparent damage, unpack the containers. Be sure all items shown on the packing list are present. If items are missing, notify Rosemount Analytical immediately.

3.2 INSTALLATION.

3.2.1 General Information

1. Although the analyzer and sample conditioning system are suitable for outdoor use, do not install them in direct sunlight or in areas of extreme temperature.

⚠ CAUTION

The TCL Total Chlorine sample conditioning system is NOT suitable for use in hazardous areas.

2. Install the analyzer and sample conditioning system in an area where vibration and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the analyzer and sensor wiring at least one foot from high voltage conductors. Be sure there is easy access to the analyzer and sample conditioning system.
4. The analyzer is suitable for panel, pipe or wall mounting. The sample conditioning enclosure must be mounted on a wall. Provide adequate room beneath the enclosure for the 5-gallon reagent carboy.
5. Be sure that the distance between the analyzer and sample conditioning cabinet does not exceed the length of the sensor cable.

3.2.2 Install the Analyzer

1. Refer to the appropriate figure for installation details.

Type of Mounting	Figure
Panel	3-1
Wall or Pipe	3-2

2. See section 4.1 for more information about the conduit openings.
3. See Section 4.2 for wiring instructions.

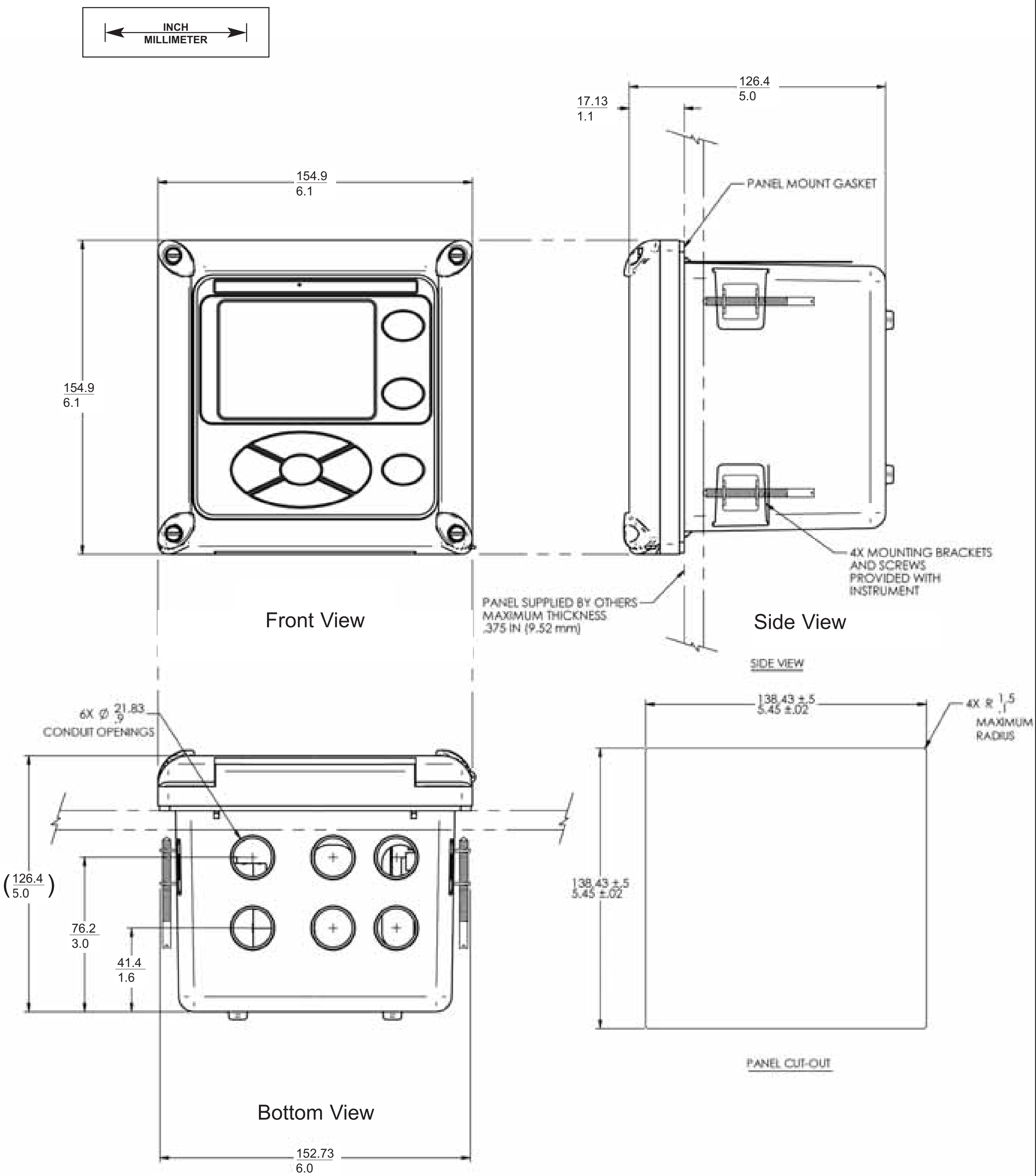


FIGURE 3-1 PANEL MOUNTING DIMENSIONS

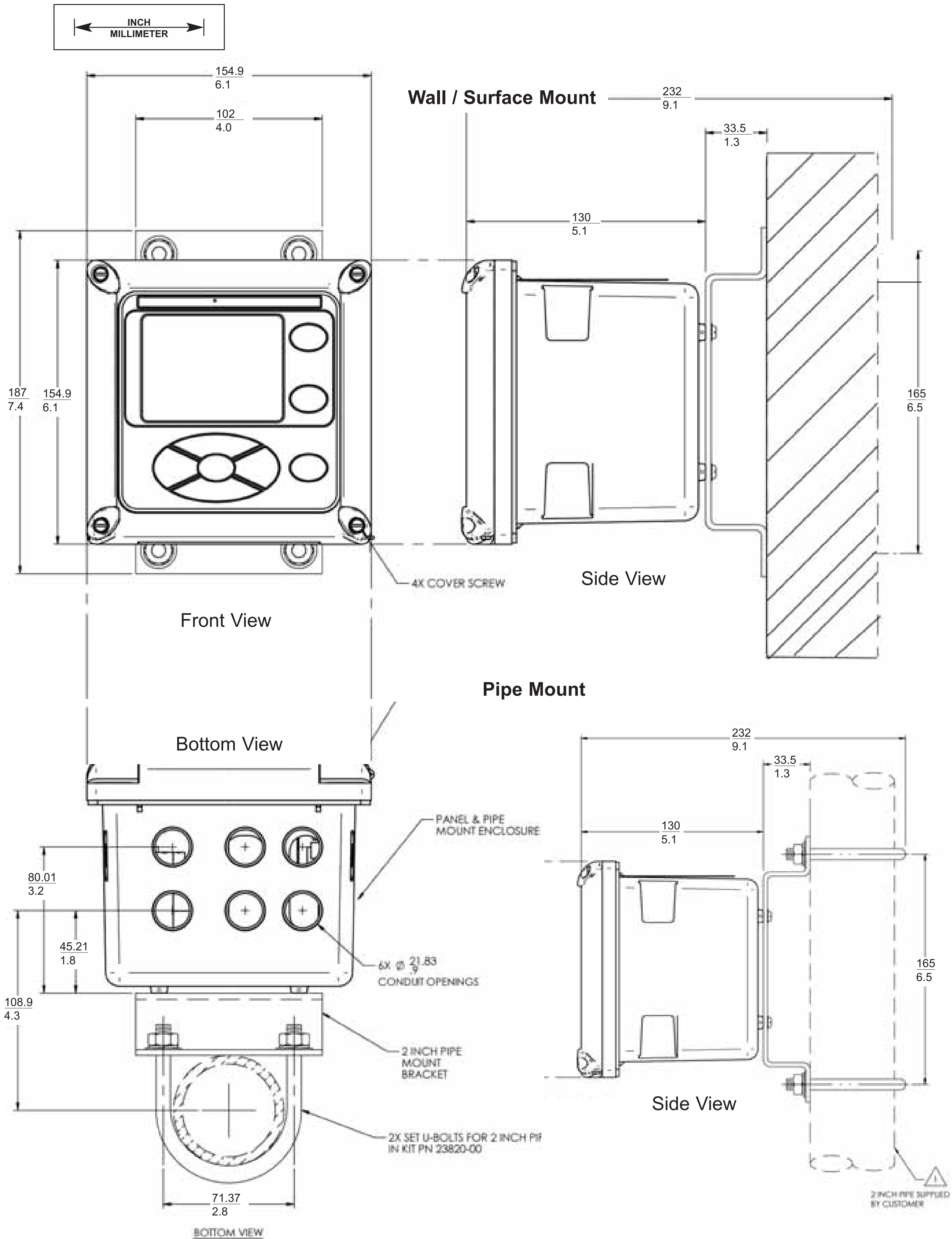


FIGURE 3-2 PIPE AND WALL MOUNTING DIMENSIONS
(Mounting bracket PN:23820-00)

3.2.3 Install the Sample Conditioning Enclosure

1. Refer to Figures 3-3, 3-4, and 3-5 for installation details.
2. Connect the sample line to the sample conditioning system. Use ¼-inch OD hard plastic or stainless steel tubing. If dechlorinated water is being measured, provide a way for occasionally substituting a chlorinated water sample for the dechlorinated sample. Chlorinated water is needed to calibrate the sensor and to check its response.
3. If a grab sample tap is not already available, install one in the process piping. Choose a point as close as possible to the sample line supplying the TCL. Be sure that opening the sample valve does not appreciably alter the flow of sample to the instrument.
4. Connect the drain to a length of ¾-inch ID flexible plastic tubing. **The sample must drain to open atmosphere.**
5. Find the reagent tubing and fitting in the plastic bag taped to the inside of the enclosure door. Screw the reagent fitting onto the bulkhead fitting at the bottom left of the enclosure. Pass the reagent tubing through the hole in the carboy cap. Be sure the plastic weight will be inside the carboy when the cap is in place. Attach the reagent tubing to the barbed connector. See Figure 3-5.
6. Place the blue plastic carboy beneath the enclosure. Screw the cap and tubing assembly on to the carboy. To prepare reagent, see Section 5.2.

3.2.4 Install the Sensor

1. From inside the sample conditioning enclosure, thread the sensor cable or VP cable through the gland on the upper left side. Leave about one foot of cable inside the enclosure.
2. Wire the cable to the analyzer. Refer to Section 4.4.
3. Remove the nut and adapter from the flow cell. Slip the nut over the end of the sensor. Thread the adapter onto the sensor. Hand tighten only. If you are using a VP cable, connect the cable to the sensor. The connector and receptacle are keyed to ensure proper mating. Once the key has slid into place, tighten the connection by turning the knurled ring clockwise. Remove the protective cap from the end of the sensor.
4. Insert the sensor in the flow cell. Hand tighten the nut.

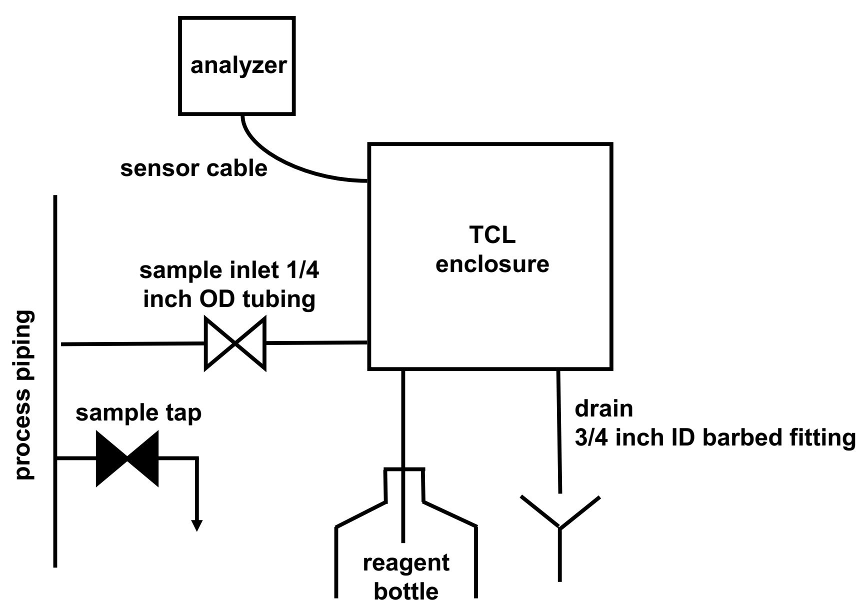


FIGURE 3-3. Installing the Sample Conditioning Enclosure

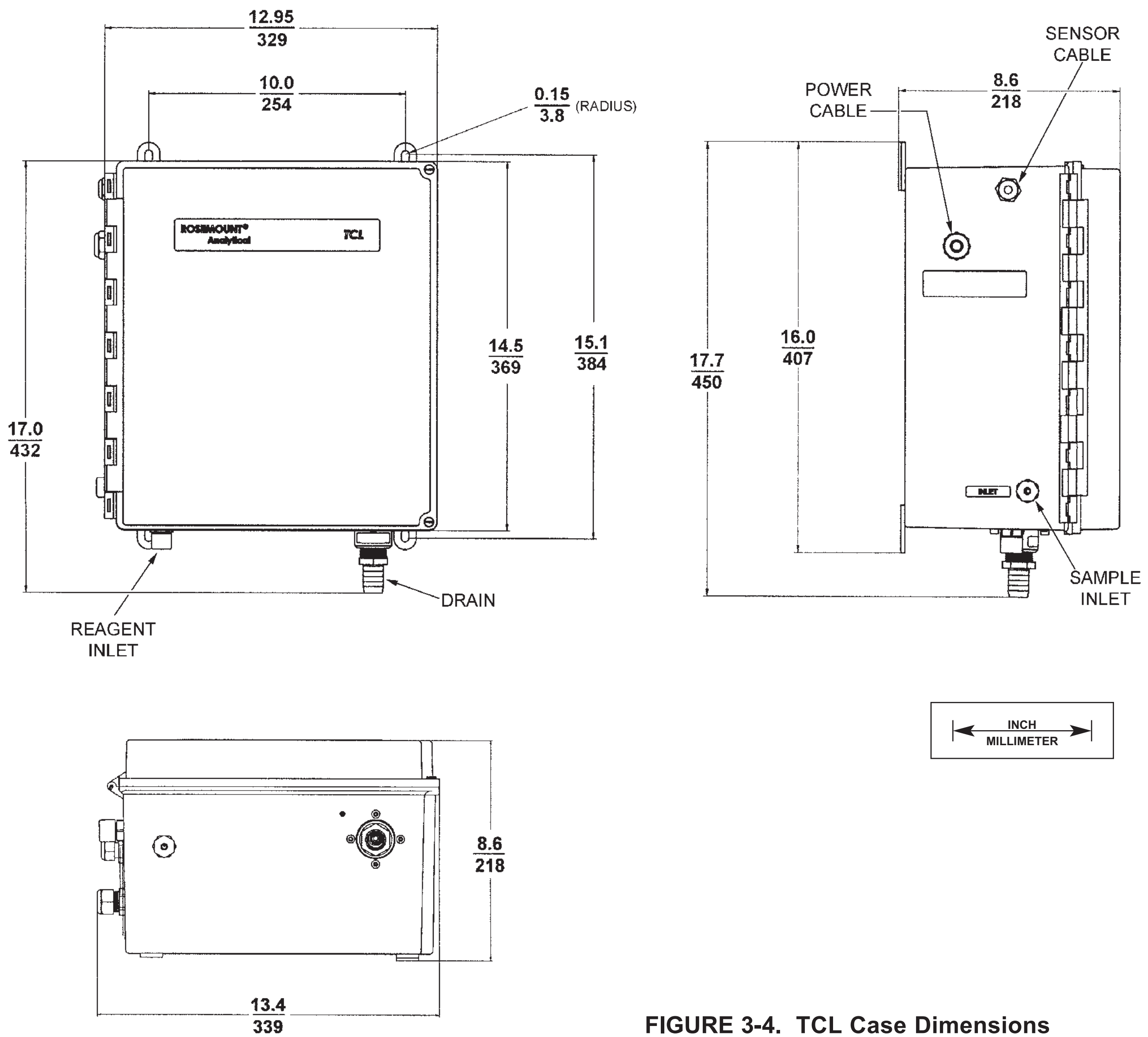


FIGURE 3-4. TCL Case Dimensions

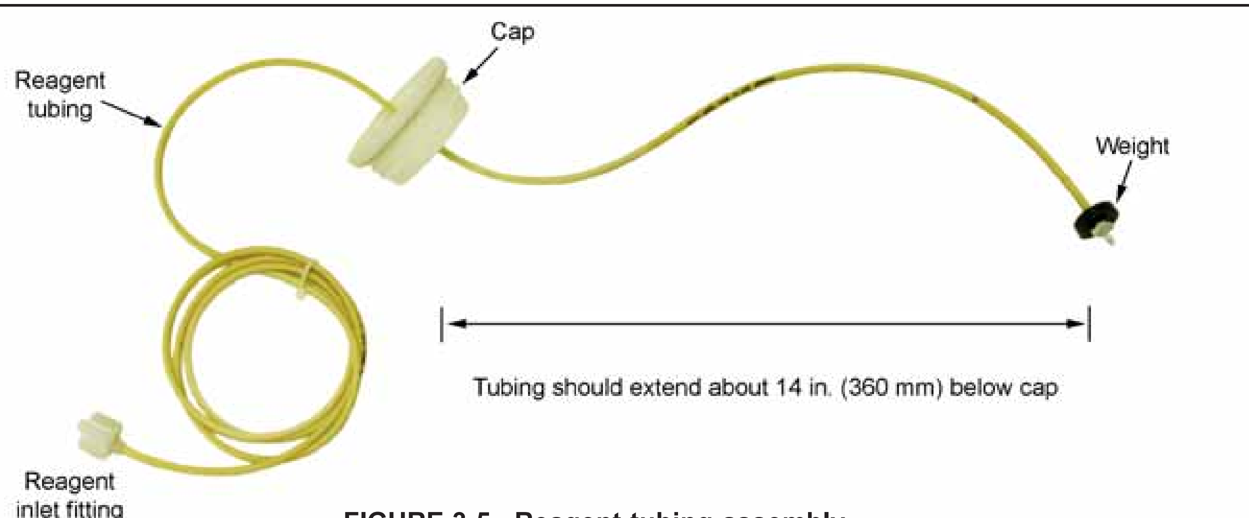


FIGURE 3-5. Reagent tubing assembly

SECTION 4. WIRING

4.1 PREPARE ANALYZER CONDUIT OPENINGS

The analyzer enclosure has six conduit openings. Four conduit openings are fitted with conduit plugs.

Conduit openings accept 1/2-inch conduit fittings or PG 13.5 cable glands. To keep the case watertight, block unused openings with NEMA 4X or IP65 conduit plugs.

NOTE

Use watertight fittings and hubs that comply with the requirements of UL514B. Connect the conduit hub to the conduit before attaching the fitting to the analyzer (UL508-26.16).

4.2 PROVIDE POWER TO THE SAMPLE CONDITIONING SYSTEM

WARNING

RISK OF ELECTRICAL SHOCK

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local code.

NOTE

Provide a switch or breaker to disconnect the sample conditioning cabinet from the main power supply. Install the switch or breaker near the unit and identify if as the disconnecting device for the sample conditioning system.

1. Be sure the pump switches on the wiring access panel are in the off position.
2. Remove the four screws securing the wiring access panel. Pull the panel out of the way to reveal the power terminal strip.
3. Insert the power cable through the strain relief connection labeled power (see Figure 3-4). Wire the power cable to the terminal strip as shown in Figure 4-1. Do not apply 230 Vac power to a 115 Vac TCL (Model option -11). Doing so will damage the instrument.
4. **Leave the pump power switches off until ready to start up the unit.** See Section 5.

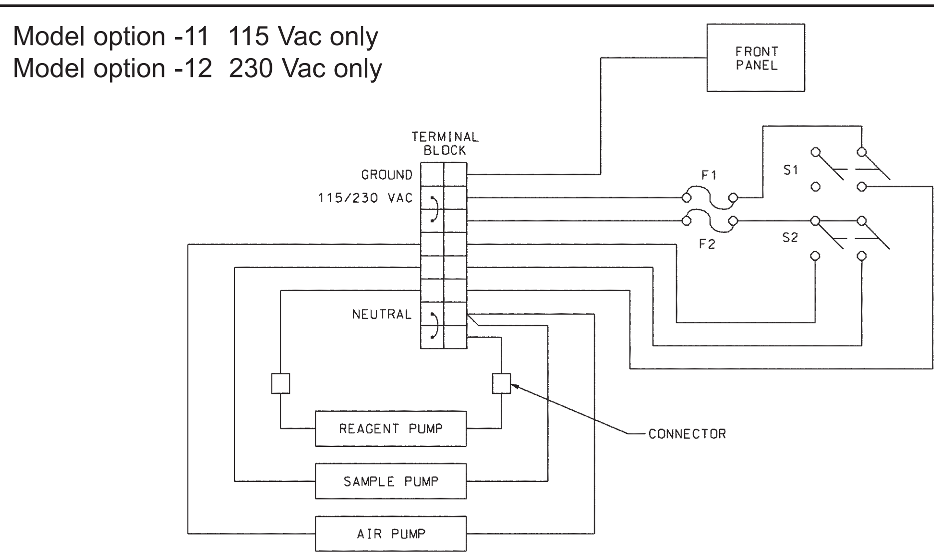


FIGURE 4-1. Power Wiring

4.3 MAKE POWER, ALARM, OUTPUT, AND SENSOR CONNECTIONS IN THE ANALYZER

WARNING

RISK OF ELECTRICAL SHOCK

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local code.

4.3.1 Power

Wire AC mains power to the power supply board, which is mounted vertically on the left hand side of the analyzer enclosure. The power connector is at the top of the board. Unplug the connector from the board and wire the power cable to it. Lead connections are marked on the connector. (L is live or hot; N is neutral, the ground connection has the standard symbol.)

AC power wiring should be 14 gauge or greater. Run the power wiring through the conduit opening nearest the power terminal. Provide a switch or breaker to disconnect the analyzer from the main power supply. Install the switch or breaker near the analyzer and label it as the disconnecting device for the analyzer.

CAUTION

If your 1056 analyzer **does not have** alarm relays (options -270, -271, or -272) you must set the black and red AC power switch located below the power terminal to the correct AC voltage. The analyzer is shipped with the switch in the 230 VAC position. For operation at 110-120 VAC, slide the switch upward so that 115 VAC is showing.

If your 1056 analyzer **has** alarm relays (options -273, -274, or -275) there is no switch setting to make. The analyzer automatically detects the AC voltage.

4.3.2 Analog output wiring

Two analog current outputs are located on the main circuit board, which is attached to the inside of the enclosure door. Figure 4-3 shows the location of the terminals. The connectors can be detached for wiring. TB-1 is output 1. TB-2 is output 2. Polarity is marked on the circuit board.

For best EMI/RFI protection, use shielded output signal cable enclosed in earth-grounded metal conduit.

Keep output signal wiring separate from power wiring. Do not run signal and power or relay wiring in the same conduit or close together in a cable tray.

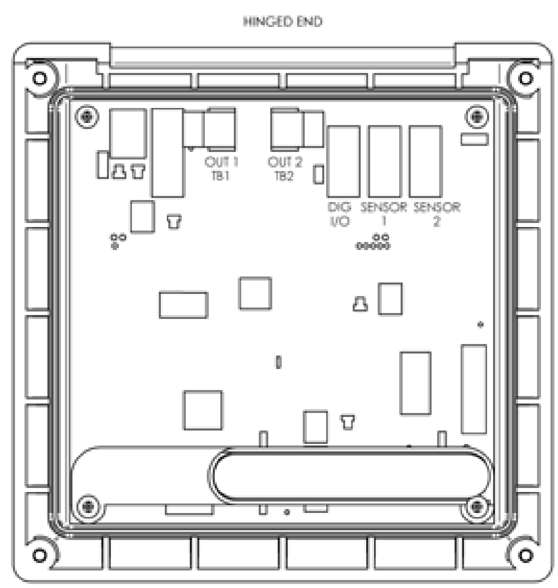


FIGURE 4-2. Analog output connections. The analog outputs are on the main board near the hinged end of the enclosure door.

4.3.3 Alarm wiring.

WARNING

Exposure to some chemicals may degrade the sealing properties used in the following devices: Zettler Relays (K1-K4) PN AZ8-1CH12DSEA

The alarm relay terminal strip is located just below the power connector on the power supply board. See Figure 4-3.

Keep alarm relay wiring separate from signal wiring. Do not run signal and power or relay wiring in the same conduit or close together in a cable tray.

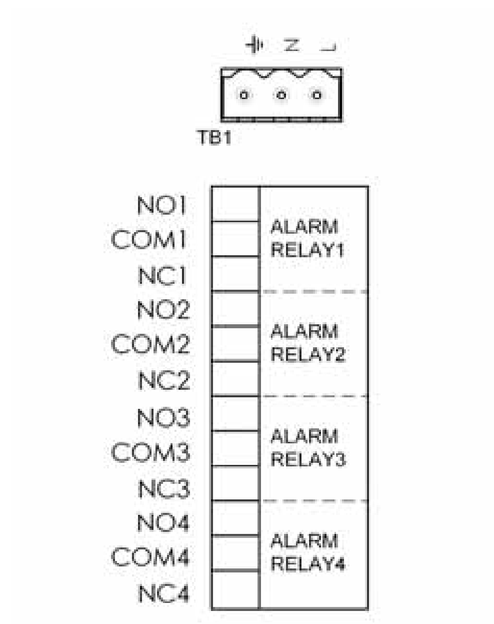


FIGURE 4-3. Alarm relay connections.

4.4 SENSOR WIRING

1. Shut off power to the analyzer.
2. Locate the chlorine signal board.

Slot 1 (left)	Slot 2 (center)	Slot 3 (right)
communication	input 1 (chlorine)	input 2 (optional)

3. Insert the sensor cable through the conduit opening nearest the chlorine board.
4. Slide the board forward to gain access to the wires and terminal screws.
5. Connect the sensor cable to the chlorine board. Refer to Figure 4-4 or 4-5.
6. Once the cable has been connected, slide the board fully into the enclosure while taking up the excess cable through the conduit opening. If you are using a cable gland, tighten the gland nut to secure the cable and ensure a sealed enclosure.

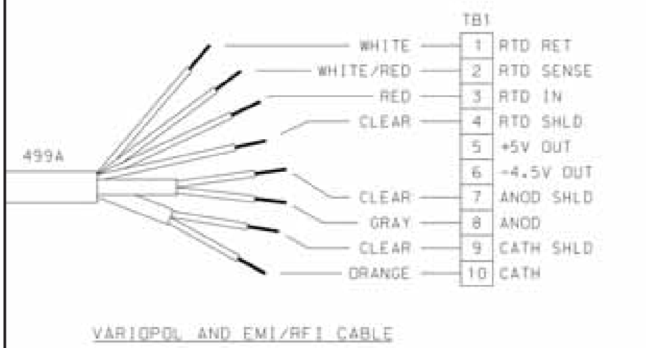


FIGURE 4.4. Wiring Sensor with Optimum EMI/RFI or Variopol Cable to Model 1056 Analyzer

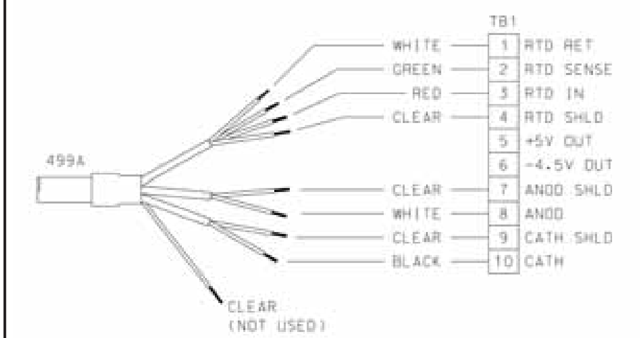
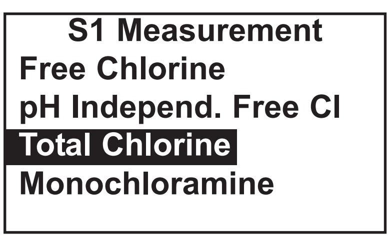


FIGURE 4.5 Wiring Sensor with Standard Cable to Model 1056 Analyzer

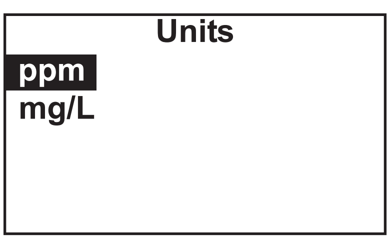
4.5 APPLY POWER TO THE ANALYZER AND COMPLETE QUICK START

1. Once all wiring connections are secured and verified, apply power to the analyzer.
2. When the analyzer is powered up for the first time, **Quick Start** screens appear. Using **Quick Start** is easy.
   a. A backlit field shows the position of the cursor.
   b. To move the cursor left or right, use the keys to the left or right of the ENTER key. To scroll up or down or to increase or decrease the value of a digit, use the keys above and below the ENTER key. Use the left and right keys to move the decimal point.
   c. Press ENTER to store a setting. Press EXIT to leave without storing changes. Pressing EXIT also returns the display to the initial Quick Start screen.
   d. A vertical black bar with a downward pointing arrow on the right side of the screen means there are more items to display. Continue scrolling down to display all the items. When you reach the bottom of the list, the arrow will point up.

3. Choose the desired language. Scroll down to display more choices.



4. Choose total chlorine for sensor 1 **(S1)**.



5. Choose the desired units for chlorine.

Temp Units
°C
°F

6. Choose the desired temperature units.

7. The main display appears. The outputs and alarms (if an alarm board is present) are assigned to default values.

8. To change outputs, alarms, and other settings go to the main menu and choose **Program**. Follow the prompts. A menu tree is on the following page. To calibrate the sensor refer to section 9.

MENU TREE

Calibrate
- **Sensor 1 (Total chlorine)**
  - Chlorine
    - Zero
    - In process
  - Temperature
- **Output 1**
- **Output 2**

Hold
- **Sensor 1**
- **Sensor 2**

Display
- **Main format configuration**
- **Language selection**
- **Warning (enable or disable)**
- **Screen contrast**

Program
- **Outputs**
  - Range (assign values to 4 and 20 mA)
  - Configure
    - Output 1 or 2
      - Assign sensor and measurement
      - Range
      - Scale
      - Dampening
      - Fault mode (fixed or live)
      - Fault value (output current)
  - Simulate
- **Alarms**
  - Configure/Setpoint
  - Alarm 1, 2, 3, or 4
    - Setpoint
    - Assign sensor and measurement
    - High or low logic
    - Deadband
    - Interval time
    - On time
    - Recovery time
  - Simulate
  - Synchronize timers
- **Measurement**
  - Total chlorine (sensor 1)
    - Measurement selection
    - Units
    - Filter
    - Resolution
- **Temperature**
  - Units
  - Temperature compensation (auto or manual)
  - Set manual temperature (if selected)
- **Security**
  - Calibrate/Hold only
  - All
- **Reset Analyzer**

SECTION 5. START-UP

NOTE

Complete Section 4 before starting this section.

5.1 PREPARE THE REAGENT

WARNING

The reagent contains potassium iodide dissolved in distilled vinegar or 5% acetic acid. Avoid contact with skin and eyes. Wash thoroughly after using.

1. **DO NOT PREPARE THE SOLUTION UNTIL READY TO USE.**
2. Position the blue plastic carboy under the sample conditioning cabinet. Unscrew the cap and reagent tube assembly.
3. Add the potassium iodide reagent to the carboy. See the table.

Expected range, ppm as Cl2	Amount of KI needed per 5 gal (19 L) of vinegar	Part number
0 – 5 ppm	25 grams	24164-00
0 – 10 ppm	50 grams	24164-01
0 – 20 ppm	2 x 50 grams	24164-01

4. Add five gallons (19 L) of distilled white vinegar one gallon (4 L) at a time. Swirl the carboy after each addition
5. Screw the cap on the carboy. Be sure the reagent uptake tube extends to the bottom of the carboy.
6. If it hasn't already been connected, connect the reagent tube to the small fitting on the bottom left hand side of the enclosure.

NOTE

The shelf life of the potassium iodide vinegar solution is at least two months if stored in the blue carboy. Do not store the reagent in a container other than the blue carboy. The reagent is sensitive to sunlight, which the blue carboy effectively blocks.

5.2 ZERO THE SENSOR

1. Place the sensor in a beaker of deionized water or simply place the sensor in air.
2. Let the sensor operate until the sensor current is stable, then zero the sensor. See Section 9.3.2 for detailed instructions.

5.3 START SAMPLE FLOW

Adjust the sample flow until a slow stream of liquid is running down the inside tube of the sampling cup.

5.4 BEGIN OPERATION AND CALIBRATE THE SENSOR

1. Turn on the reagent and sample pump switches. Observe that liquid begins to fill the flow cell. The sample flow is about 11 mL/min, so the flow cell will fill rather slowly. Also observe that the air pump is operating. The pump will produce very vigorous bubbling in the flow cell.
2. Once the flow of reagent starts, it takes about two minutes for the reagent to reach the flow cell. If the concentration of total chlorine in the sample is greater than about 0.5 ppm, the treated sample in the flow cell will be pale yellow. Sample containing more chlorine will be dark yellow.
3. Monitor the sensor current. Once the reading is stable, calibrate the unit. See Section 9.3.3 for detailed instructions. It may take thirty minutes or longer for the reading to stabilize when the sensor is first put in service.

SECTION 6. DISPLAY AND OPERATION

6.1. DISPLAY

The analyzer has a six line display. See Figure 6-1. The display can be customized to meet user requirements. Refer to section 6.6.

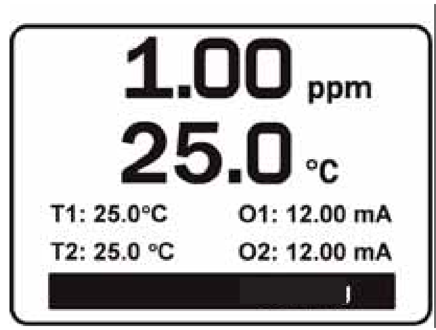


FIGURE 6-1. Main Display

When the analyzer is being programmed or calibrated, the display changes to a screen similar to the one shown in Figure 6-2. The live readings appear in small font at the top of the screen. The rest of the display shows programming and calibration information. Programming items appear in lists. The screen can show only four items at a time, and the arrow bar at the right of the screen indicates whether there are additional items in the list. See Figure 6.3 for an explanation of the arrow bar.

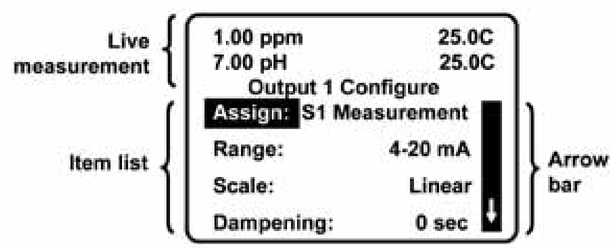


FIGURE 6-2. Programming Screen Showing Item List. The position of the cursor is shown in reverse video. See Section 4.2 and 4.3 for more information.

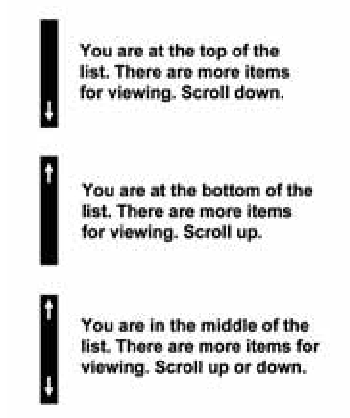


FIGURE 6-3. Arrow Bar. The arrow bar shows whether additional items in a list are available.

6.2 KEYPAD

Local communication with the analyzer is through the membrane keypad. Figures 6-4 and 6-5 explain the operation of the keys.

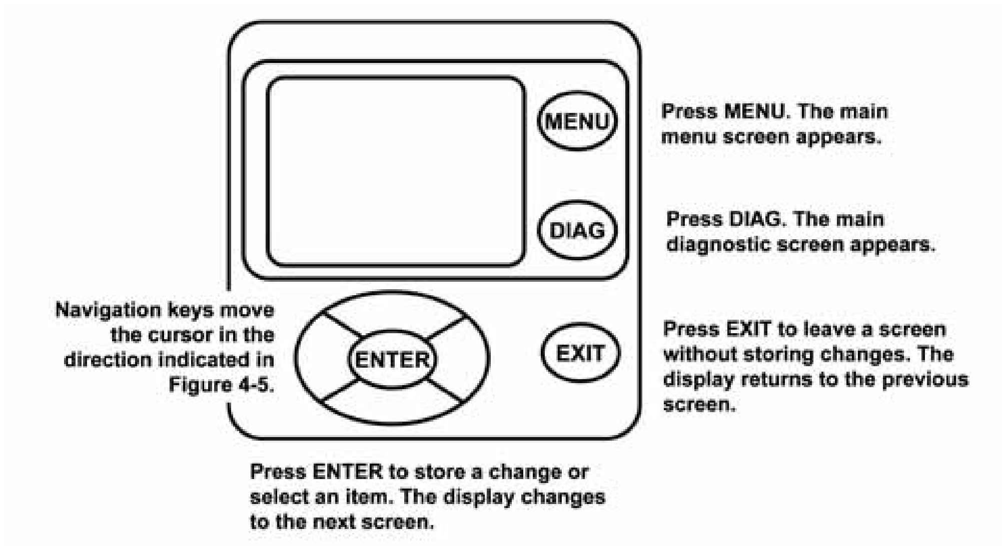


FIGURE 6-4. Analyzer keypad. Four navigation keys move the cursor around the screen. The position of the cursor is shown in reverse video. The navigation keys are also used to increase or decrease the value of a numeral. Pressing ENTER selects an item and stores numbers and settings. Pressing EXIT returns to the previous screen without storing changes. Pressing MENU always causes the main menu to appear. .

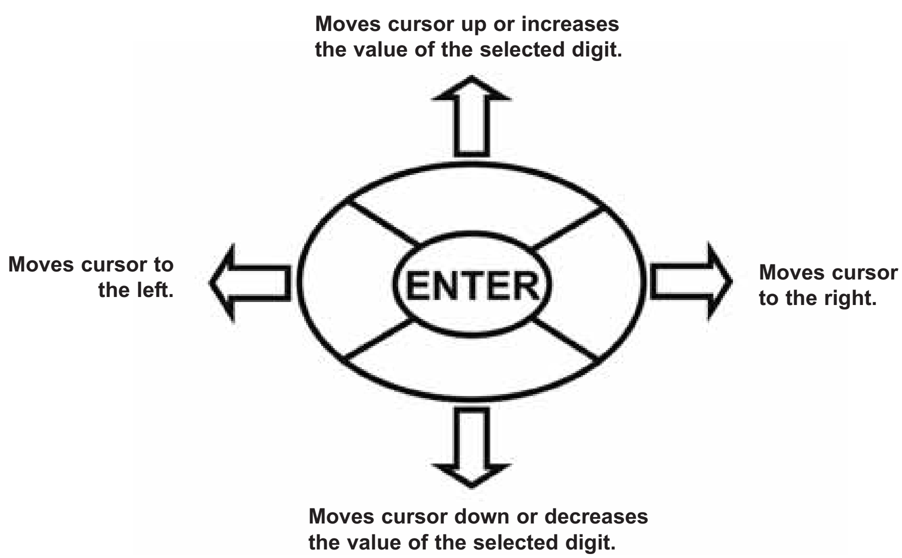


FIGURE 6-5. Navigation keys. The operation of the navigation keys is shown. To move a decimal point, highlight it, then press the up or down key

6.3 PROGRAMMING THE ANALYZER—TUTORIAL

Setting up and calibrating the analyzer is easy. The following tutorial describes how to move around in the programming menus. For practice, the tutorial also describes how to assign ppm chlorine values to the 4 and 20 mA analog outputs.

Menu
Calibrate
Hold
Program
Display

1. Press MENU. The main menu screen appears. There are four items in the main menu. **Calibrate** is in reverse video, meaning that the cursor is on Calibrate.

2. To assign values to the analog outputs, the **Program** sub-menu must be open. Use the down navigation key to move the cursor to **Program**. Press ENTER.

Program
Outputs
Alarms
Measurement
Temperature ↓

3. The Program menu appears. There are between five and seven items in the Program menu. Alarms appears only if the analyzer contains the optional alarm relay board. The screen displays four items at a time. The downward pointing arrow on the right of the screen shows there are more items available in the menu. To view the other items, use the down key to scroll to the last item shown and continue scrolling down. When you have reached the bottom, the arrow will point up. Move the cursor back to **Outputs** and press ENTER.

Outputs
Range
Configure
Stimulate

4. The screen at left appears. The cursor is on **Range. Output Range** is used to assign values to the low and high current outputs. Press ENTER.

Output Range
O1 S1 4mA 0.000 ppm
O1 S1 20mA: 10.00 ppm
O2 S1 4mA: 0.0C
O2 S1 20mA: 100.0C

5. The screen at left appears. The screen shows the present values assigned to output 1 **(O1)** and output 2 **(O2)**. The screen also shows which sensors the outputs are assigned to. **S1** is sensor 1 and **S2** is sensor 2. **S2** appears only if you have a dual input 1056 analyzer. The assignments shown are the defaults for a single channel chlorine analyzer. Outputs are freely assignable under the configure menu.

O1 S1 20 mA
10.00 ppm

6. For practice, change the 20 mA setting for output 1 to 8.5 ppm.
   a. Move the cursor to the **O1 S1 20 mA: 10.00** line and press ENTER.
   b. The screen at left appears.
   c. Use the navigation keys to change 10.00 to 8.5 ppm. Use the left and right keys to move from digit to digit. Use the up and down keys to increase or decrease the numeral.
   d. To move the decimal point, press the left or right navigation key until the decimal point is highlighted. Press the up key to move the decimal point to the right. Press the down key to move to the left.
   e. Press ENTER to store the setting.

```
        Output Range
O1 S1 4mA:   0.000 ppm
O1 S1 20mA:  08.50 ppm
O2 S1 4mA:        0.0C
O2 S1 20mA:     100.0C
```

7. The display returns to the summary screen at left. Note that the 20 mA setting for output1 has changed to 8.5 ppm.

8. To return to the main menu, press MENU. To return to the main display, press MENU then EXIT.

6.4 SECURITY

6.4.1 How the Security Code Works

Security codes prevent accidental or unwanted changes to program settings or calibrations. There are three levels of security.

a. A user can view the default display and diagnostic screens only.
b. A user has access to the calibration and hold menus only.
c. A user has access to all menus.

```
     Security Code
000
```

1. If a security code has been programmed, pressing MENU causes the security screen to appear.

2. Enter the three-digit security code.

3. If the entry is correct, the main MENU screen appears. The user has access to the sub-menus the code entitles him to.

4. If the entry is wrong, the invalid code screen appears.

6.4.2 Assigning Security Codes.

See Section 7.7.

6.4.3 Bypassing Security Codes

Call the factory.

6.5 USING HOLD

6.5.1 Purpose

To prevent unwanted alarms and improper operation of control systems or dosing pumps, place the alarms and outputs assigned to the sensor in hold before removing it for maintenance. During hold, outputs assigned to the sensor remain at the last value, and alarms assigned to the sensor remain in their present state.

Once in hold, the sensor remains in hold until hold is turned off. However, if power is lost then restored, hold will automatically be turned off.

6.5.2 Using the Hold Function.

1. Press MENU. The main menu screen appears. Move the cursor to **Program.**

Menu
Calibrate
Hold
Program
Display

2. Choose HOLD.

Hold	
S1 Hold	No
S2 Hold	No

3. The screen shows the current hold status for each sensor. Select the sensor to be put in hold. Press ENTER.

S1 Hold outputs and alarms?
No
Yes
No

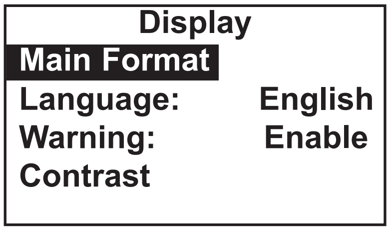
4. To put the sensor in hold, choose **Yes.** To take the sensor out of hold, choose **No.**

   Once in hold, the sensor remains in hold until hold is turned off. However, if power is lost then restored, hold will automatically be turned off.

6.6 CONFIGURING THE MAIN DISPLAY

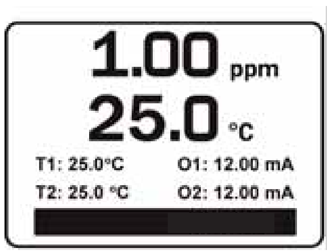
The main display can be configured to meet user requirements.

1. Press MENU. The main menu screen appears. Move the cursor to **Display** and press ENTER.



2. The screen shows the present configuration. There are four items: **Main Format, Language, Warning, and Contrast.**

   To make a change, move the cursor to the desired line and press ENTER. A screen appears in which the present setting can be edited. Press ENTER to store the setting.



3. **Main Format** lets you configure the second line in the main display as well as the four smaller items at the bottom of the display. Move the cursor to the desired place in the screen and press ENTER. Scroll through the list of items and select the parameter you wish displayed. Once you are done making changes, press EXIT twice to return to the display menu. Press MENU then EXIT to return to the main display.

   The following abbreviations are used in the quadrant display.

O	output
T	temperature (live)
Tm	temperature (manual)
M	measurement
I	sensor current (Cl)

   If you have a dual input 1056 analyzer, other abbreviations might appear. Consult the 1056 instruction manual for more details.

4. Choose **Language** to change the language used in the display.

5. Choose **Warning** to disable or enable warning messages.

6. Choose **Contrast** to change the display contrast. To change the contrast, choose either lighter or darker and press ENTER. Every time you press ENTER the display will become lighter or darker.

SECTION 7. PROGRAMMING THE ANALYZER

7.1 GENERAL

This section describes how to make the following program settings using the local keypad.

a. Configure and assign values to the analog current outputs.
b. Configure and assign values to the alarm relays (if the alarm board is installed).
c. Choose the type of chlorine measurement being made. This step is necessary because the analyzer used with the TCL can measure forms of chlorine other than total chlorine.
d. Choose temperature units and automatic or manual temperature correction.
e. Set two levels of security codes.
f. Reset the analyzer to factory default settings.

7.2 DEFAULT SETTINGS

The analyzer leaves the factory with the default settings for total chlorine shown in Table 7.1. The setting can be changed by the user to any value shown in the column labeled CHOICES. If you have a dual input 1056 analyzer, refer to the 1056 instruction manual for information about the default settings for second input.

TABLE 7-1. DEFAULT SETTINGS

ITEM	CHOICES	DEFAULT
Outputs		
1. Assignments		
a. output 1	chlorine, temp	chlorine
b. output 2	chlorine, temp	temp
2. Range	0-20 or 4-20 mA	4 – 20 mA
3. 0 or 4 mA setting		
a. chlorine	-9999 to +9999	0
b. temperature	-999.9 to +999.9	0
4. 20 mA setting		
a. chlorine	-9999 to +9999	10
b. temperature	-999.9 to +999.9	0
5. Fault current (fixed)	0.00 to 22.00 mA	22.00 mA
6. Dampening	0 to 999 sec	0 sec
7. Simulate	0.00 to 22.00 mA	12.00 mA
Alarms		
1. Logic	high or low	AL1 low, AL2,3,4 high
2. Assignments		
a. AL1 and AL2	chlorine, temp, fault, interval timer	chlorine
b. AL3 and AL4	chlorine, temp, fault, interval timer	temperature
3. Deadband	0 to 9999	0
4. Interval timer settings		
a. interval time	0.0 to 999.9 hr	24.0 hr
b. on time	0 to 999 sec	10 sec
c. recovery time	0 to 999 sec	60 sec
Measurement (Chlorine)		
1. units	ppm or mg/L	ppm
2. resolution	0.01 or 0.001	0.001
3. input filter	0 to 999 sec	5 sec

TABLE 7-1. DEFAULT SETTINGS (continued)

ITEM	CHOICES	DEFAULT
Temperature related settings		
1. Units	ºC or ºF	ºC
2. Temperature compensation	automatic or manual	automatic
Security Code		
1. Calibrate/Hold	000 to 999	000
2. Program/Display	000 to 999	000
Calibration–Analog Outputs		
1. 4 mA	0.000 to 22.000 mA	4.000 mA
2. 20 mA	0.000 to 22.000 mA	20.000 mA

7.3 CONFIGURING, RANGING, AND SIMULATING OUTPUTS.

7.3.1 Purpose

This section describes how to configure, range, and simulate the two analog current outputs. **CONFIGURE THE OUTPUTS FIRST.**

1. Configuring an output means…
   a. Assigning a sensor and measurement (chlorine or temperature) to an output.
   b. Selecting a 4-20 mA or 0-20 mA output.
   c. Choosing a linear or logarithmic output.
   d. Turning output current dampening on or off.
   e. Selecting the value the output current goes to if the analyzer detects a fault.
2. Ranging the outputs means assigning values to the low (0 or 4 mA) and high (20 mA) outputs.
3. Simulating an output means making the analyzer generate an output current equal to the value entered by the user.

7.3.2 Definitions

1. ANALOG CURRENT OUTPUT. The analyzer provides either a continuous 4-20 mA or 0-20 mA output signal proportional to chlorine or temperature.
2. ASSIGNING AN OUTPUT. Outputs can be assigned to either the measurement (total chlorine) or temperature. If a dual input analyzer is being used, the outputs are freely assignable to either sensor.
3. LINEAR OUTPUT. Linear output means the current is directly proportional to the value of the variable assigned to the output (chlorine or temperature).
4. LOGARITHMIC OUTPUT. Logarithmic output means the current is directly proportional to the common logarithm of the variable assigned to the output (chlorine or temperature).
5. DAMPENING. Output dampening smoothes out noisy readings. It also increases response time. The time selected for output dampening is the time to reach 63% of the final reading following a step change. Output dampening does not affect the response time of the display.
6. FAULT. The analyzer continuously monitors itself and the sensor(s) for faults. If the analyzer detects a fault, a fault message appears in the main display. At the same time the output current goes to the value programmed in this section. There are two output fault modes: fixed and live. Fixed means the selected output goes the previously programmed value (between 0.00 and 22.00 mA) when a fault occurs. Live means the selected output is unaffected when a fault occurs.
7. RANGING AN OUTPUT. The outputs are fully rangeable, including negative numbers. If the output is logarithmic, assigned values must be positive.

7.3.3. Procedure – Configure Outputs.

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.

Program
Outputs
Alarms
Measurement
Temperature

2. The cursor will be on **Outputs.** Press ENTER.

Outputs
Range
Configure
Simulate

3. Choose **Configure.**

Output 1 Configure
Output 1
Output 2

4. Choose **Output 1** or **Output 2**.

Output 1 Configure

Assign:	**S1 Meas**
Range:	**4-20 mA**
Scale:	**Linear**
Dampening	**0 sec**

5. The screen shows the present configuration. There are six items: **Assign** (**S1** is sensor 1, **S2** is sensor 2), **Range, Scale, Dampening, Fault Mode,** and **Fault Value** To display the fifth and sixth items, scroll to the bottom of the screen and continue scrolling.

   To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. Press ENTER to store the setting.

   For an explanation of terms, see sections 7.3.1 and 7.3.2.

6. To return to the main display, press MENU then EXIT.

7.3.3. Procedure – Ranging Outputs.

1. Press MENU. The main menu screen appears. Move the cursor to **Program** and press ENTER.

```
Program
Outputs
Alarms
Measurement
Temperature
```

2. The cursor will be on **Outputs**. Press ENTER.

```
Outputs
Range
Configure
Simulate
```

3. Choose **Range**.

```
Output Configure
Output 1
Output 2
```

4. Choose **Output 1** or **Output 2**.

```
Output Range
O1 S1 4mA    0.000 ppm
O1 S1 20mA: 10.00 ppm
O2 S1 4mA:        0.0C
O2 S1 20mA:     100.0C
```

5. The screen shows the present settings for the outputs. **O1** is output 1, **O2** is output 2, **S1** is sensor 1, and **S2** is sensor 2.

   To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. Press ENTER to store the setting.

   For an explanation of terms, see sections 7.3.1 and 7.3.2.

6. To return to the main display, press MENU then EXIT.

7.3.4 Procedure – Simulating Outputs

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.

Program
Outputs
Alarms
Measurement
Temperature

2. The cursor will be on **Outputs**. Press ENTER.

Outputs
Simulate
Configure
Simulate

3. Choose **Simulate**.

Simulate
Output 1
Output 2

4. Choose **Output 1** or **Output 2**.

Output 1 Hold at
12.00 mA

5. Enter the desired simulated output current. To end the simulated current, press MENU or EXIT.

7.4 CONFIGURING ALARMS AND ASSIGNING SETPOINTS.

7.4.1 Purpose

The Model 1056 analyzer has an **optional** alarm relay board. This section describes how to configure and assign setpoints to the alarm relays, simulate alarm action, and synchronize interval timers. CONFIGURE THE ALARMS FIRST.

1. Configuring an alarm means…
   a. Assigning a measurement (chlorine or temperature) to an alarm. If a dual input analyzer is being used, the alarms are freely assignable to either sensor. An alarm relay can also be used as a timer.
   b. Selecting high or low logic.
   c. Choosing a deadband.
   d. Setting the interval timer parameters.
2. Simulating an alarm means making the analyzer energize or de-energize an alarm relay.

7.4.2 Definitions

1. ASSIGNING ALARMS. There are four alarms relays. The relays are freely assignable to any sensor and to either the measurement (chlorine) or temperature. Alarm relays can also be assigned to operate as interval timers or as fault alarms. A fault alarm activates when the analyzer detects a fault in either itself or the sensor.
2. FAULT ALARM. A fault condition exits when the analyzer detects a problem with a sensor or with the analyzer itself that is likely to cause seriously erroneous readings. If an alarm was programmed as a fault alarm, the relay will activate. At the same time a fault message will appear in the main display.
3. ALARM LOGIC, SETPOINTS, AND DEADBANDS. See Figures 7-1 and 7-2.
4. INTERVAL TIMER. Any alarm relay can be used as an interval timer. Figure 7-3 shows how the timer operates. While the interval timer is operating, the main display, analog output, and alarms for the sensor(s) can be put on hold. During hold, the main display remains at the last value.
5. SYNCHRONIZE TIMER. If two or more relays are being used as interval timers, choosing synchronize timers will cause each timer to start one minute later than the preceding timer.

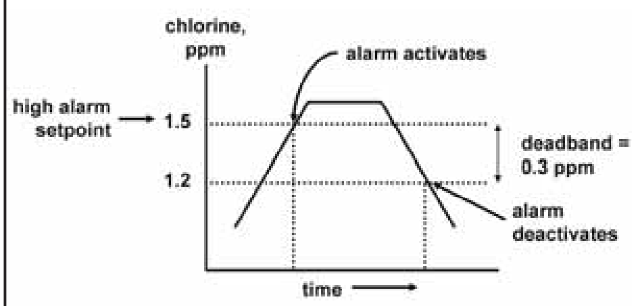


FIGURE 7-1. High alarm logic. The alarm activates when the chlorine concentration exceeds the high setpoint. The alarm remains activated until the reading drops below the value determined by the deadband.

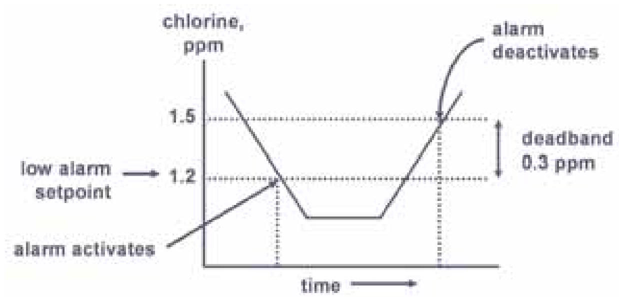


FIGURE 7-2. Low alarm logic. The alarm activates when the chlorine concentration drops below the low setpoint. The alarm remains activated until the reading increases above the value determined by the deadband.

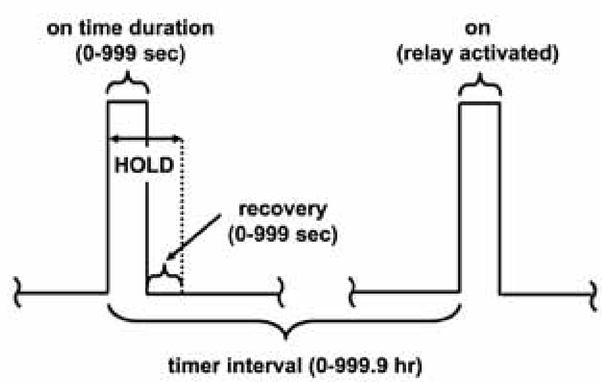


FIGURE 7-3. Operation of the interval timer. The numbers in parentheses are the allowed values for each timer parameter.

7.4.3 Procedure – Configuring Alarms and Assigning Setpoints

1. Press MENU. The main menu screen appears. Move the cursor to **Program** and press ENTER.

```
Program
Outputs
Alarms
Measurement
Temperature
```

2. Choose **Alarms.**

```
Alarms
Configure/Setpoint
Simulate
Synch Timers:      Yes
```

3. Choose **Configure/Setpoint.**

```
Configure/Setpoint
Alarm 1
Alarm 2
Alarm 3
Alarm 4
```

4. Choose **Alarm 1, Alarm 2, Alarm 3,** or **Alarm 4.**

```
Alarm 1 Settings
Setpoint:  0.000 ppm
Assign:   S1 Measure
Logic:           Low
Deadband: 0.000 ppm
```

5. The screen summarizes the present configuration and setpoints. There are nine items: **Setpoint, Assign** (**S1** is sensor 1 and **S2** is sensor 2), **Logic, Deadband, Interval time, On time, Recover time,** and **Hold while active.** The last four items describe the operation of the timer. Only four items are shown at a time. To view the remaining items, scroll to the bottom of the screen and continue scrolling.

   To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. Press ENTER to store the setting.

   For an explanation of terms, see sections 7.4.1 and 7.4.2.

6. To return to the main display, press MENU then EXIT.

7.4.4 Procedure – Simulating Alarms

1. Press MENU. The main menu screen appears. Move the cursor to **Program** and press ENTER.

Program
Outputs
Alarms
Measurement
Temperature

2. Choose **Alarms.**

Alarms
Configure/Setpoint
Simulate
Synch Timers: Yes

3. Choose **Simulate.**

Simulate
Alarm 1
Alarm 2
Alarm 3
Alarm 4

4. Choose **Alarm 1, Alarm 2, Alarm 3,** or **Alarm 4.**

Simulate Alarm 1
Don’t Simulate
De-energize
Energize

5. Choose **Don’t simulate, De-energize,** or **Energize.** Press MENU or EXIT to end simulation.

7.4.5 Procedure – Synchronizing Timers

1. **Synch Timers** is available only if two or more alarm relays have been configured as interval timers.

2. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.

```
      Program
Outputs
Alarms
Measurement
Temperature
```

3. Choose Alarms.

```
       Alarms
Configure/Setpoint
Simulate
Synch Timers:      Yes
```

4. The summary display shows the current **Synch Timers** setting, (**Yes** or **No**)

   To make a change, choose **Synch Timers** and press ENTER. A screen will appear in which the present setting can be edited. Press ENTER to store the setting.

   For an explanation of terms, see sections 7.4.1 and 7.4.2.

5. To return to the main display, press MENU then EXIT.

7.5 CONFIGURING THE MEASUREMENT.

7.5.1 Purpose

This section describes how to do the following:

1. Program the analyzer to measure total chlorine. This step is necessary because the analyzer can be used with other sensors to measure other chlorine oxidants.
2. Set the level of electronic filtering of the sensor current.
3. Set the display resolution.

7.5.2 Definitions

1. CHLORINE OXIDANTS. Although the TCL is used to measure total chlorine only, the 1056 analyzer used with the TCL can be used to measure other chlorine oxidants, for example monochloramine and free chlorine.
2. FILTER. The analyzer applies a filter to the raw sensor current. The filter reduces noise but increases the response time. The available filter(s) depend on the time setting. If the filter is between 0 and 10 seconds, the analyzer applies a window filter. A window filter averages the measured value within the filter time. For example, if the filter is 5 seconds and a step increase is applied to the input, the displayed value increases linearly, reaching the final value after 5 seconds. If the filter is set to greater than 10 seconds, the analyzer applies either an adaptive filter or a continuous filter. An adaptive filter discriminates between noise and real process change. It filters changes below a fixed threshold value but does not filter changes that exceed the threshold. It is best used in situations where the noise is relatively low. A continuous filter dampens all changes. The filter time setting is approximately equal to the time constant, the amount of time required for the reading to reach 63% of the final value following a step change.
3. RESOLUTION. If the chlorine concentration is less than 1.00 ppm (mg/L), the display resolution can be set to 0.XX or 0.XXX.

7.5.3 Procedure – Configuring the Measurement

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.

```
Program
Outputs
Alarms
Measurement
Temperature
```

2. Choose **Measurement.**

```
Configure?
Sensor 1
Sensor 2
```

3. The screen at left appears only if you have a dual input 1056. Choose the Chlorine sensor.

```
S1 Configure
Measure:        Total Cl
Units:               ppm
Filter:            5 sec
Resolution:    0.001 ppm
```

4. The screen summarizes the present configuration for the chlorine sensor. There are four items: **Measure, Units, Filter**, and **Resolution**

To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. To store the setting press ENTER.

a. For **Measurement** choose **Total Chlorine**.

b. Leave **Filter** at the default value unless readings are noisy.

For an explanation of terms, see sections 7.5.2.

6. To return to the main display, press MENU then EXIT.

7.6 CONFIGURING TEMPERATURE RELATED SETTINGS

7.6.1 Purpose

This section describes how to do the following:

1. Choose temperature units.
2. Choose automatic or manual temperature correction for membrane permeability (chlorine sensor).
3. Enter a temperature for manual temperature compensation.

7.6.2 Definitions - Chlorine

1. AUTOMATIC TEMPERATURE CORRECTION. The total chlorine sensor is a membrane-covered amperometric sensor. The permeability of the membrane is a function of temperature. As temperature increases, membrane permeability increases. Thus, an increase in temperature will cause the sensor current and the analyzer reading to increase even though the chlorine level remained constant. A correction equation in the analyzer software automatically corrects for changes in membrane permeability. In automatic temperature correction, the analyzer uses the temperature measured by the sensor for the correction.
2. MANUAL TEMPERATURE CORRECTION. In manual temperature correction, the analyzer uses the temperature entered by the user for correction. It does not use the actual process temperature. Do NOT use manual temperature correction unless the measurement and calibration temperatures differ by no more than about 2ºC. Manual temperature correction is useful if the sensor temperature element has failed and a replacement sensor is not available.

7.6.3 Procedure – Configuring Temperature Related Settings

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.

Program
Outputs
Alarms
Measurement
Temperature

2. Choose **Temperature**.

Temperature
Units: C
S1 Temp Comp: Auto

3. The screen summarizes the present sensor configuration. There will be between two and five items. **Units** and **S1 Temp Comp**, always appear. If manual temperature compensation was selected, the manual temperature value will also appear. If you have a dual input analyzer, temperature compensation items will appear for the other sensor. Only four items are shown at a time. To view the remaining items, scroll to the bottom of the screen and continue scrolling.

   To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. To store a setting, press ENTER.

   For an explanation of terms, see sections 7.6.1 and 7.6.2.

4. To return to the main display, press MENU then EXIT.

7.7 CONFIGURING SECURITY SETTINGS

7.7.1 Purpose

This section describes how to set security codes. There are three levels of security.

a. A user can view the default display and diagnostic screens only.

b. A user has access to the calibration and hold menus only.

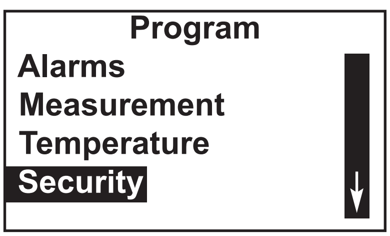
c. A user has access to all menus.

The security code is a three digit number. The table shows what happens when different security codes (XXX and YYY) are assigned to **Calibration/Hold** and **All**. 000 means no security.

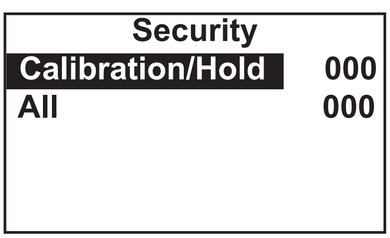
Calibration/Hold	All	What happens…
000	XXX	User enters XXX and has access to all menus.
XXX	YYY	User enters XXX and has access to Calibration and Hold menus only. User enters YYY and has access to all menus.
XXX	000	User needs no security code to have access to all menus.
000	000	User needs no security code to have access to all menus.

7.7.2 Procedure – Configuring Security Settings

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.



2. Scroll to the bottom of the screen and continue scrolling unit **Security** is highlighted. Press ENTER.



3. The screen shows the existing security codes. To make a change, move the cursor to the desired line and press ENTER. A screen will appear in which the present setting can be edited. Press ENTER to store the change. The security code takes effect two minutes after pressing ENTER.

4. To return to the main display, press MENU then EXIT.

7.8 RESETTING THE ANALYZER

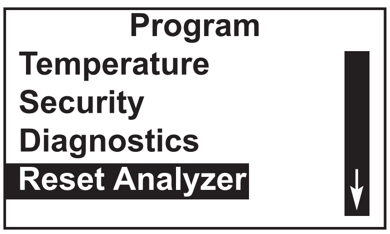
7.8.1 Purpose

This section describes how to clear user-entered values and restore default settings. There are three resets:

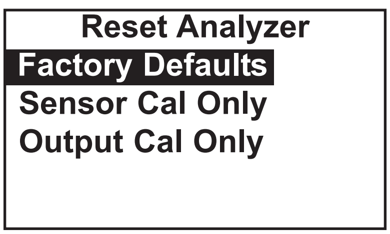
1. Resetting to factory default values clears **ALL** user entered settings, including sensor and analog output calibration, and returns **ALL** settings and calibration values to the factory defaults.
2. Resetting a sensor calibration to the default values clears user-entered calibration data for the selected sensor but leaves all other user-entered data unaffected.
3. Resetting the analog output calibration clears only the user-entered analog output calibration. It leaves all other user-entered settings unchanged.

7.8.2 Procedure – Resetting the Analyzer

1. Press MENU. The main menu screen appears. Move the cursor to Program and press ENTER.



2. Scroll to the bottom of the screen and continue scrolling until **Reset Analyzer** is highlighted. Press ENTER.



3. Choose whether to reset all user-entered values **(Factory Defaults)**, sensor calibration **(Sensor Cal Only)**, or output calibration **(Output Cal Only).** If you choose **Sensor Cal Only** or **Output Cal Only** a second screen appears in which you can select which sensor or output calibration to reset.

4. To return to the main display, press MENU then EXIT.

SECTION 8. DIGITAL COMMUNICATIONS

For information about digital communications, refer to the following manuals:

HART	51-1056HT Model 56 HART Addendum
Profibus DP	51-1056DP Model 56 Profibus DP Addendum

SECTION 9. CALIBRATION

9.1 INTRODUCTION

The calibrate menu allows the user to do the following:

1. Calibrate the temperature sensing element in the total chlorine sensor.
2. Calibrate the chlorine sensor.
3. Calibrate the analog outputs.

9.2 CALIBRATING TEMPERATURE

9.2.1 Purpose

The total chlorine sensor is a membrane-covered amperometric sensor. As the sensor operates, iodine, produced by the reaction between total chlorine and the vinegar/potassium iodide reagent, diffuses through the membrane and is consumed at an electrode immediately behind the membrane. The reaction produces a current that depends on the rate at which iodine diffuses through the membrane. The diffusion rate, in turn, depends on the concentration of the iodine and how easily it passes through the membrane (the membrane permeability). Because membrane permeability is a function of temperature, the sensor current will change if either the concentration or temperature changes. To account for changes in sensor current caused by temperature alone, the analyzer automatically applies a membrane permeability correction. The membrane permeability changes about 3%/°C at 25°C, so a 1°C error in temperature produces about a 3% error in the reading.

Without calibration the accuracy of the temperature measurement is about ±0.4°C. Calibrate the sensor/analyzer unit if...

1. ±0.4°C accuracy is not acceptable
2. the temperature measurement is suspected of being in error. Calibrate temperature by making the analyzer reading match the temperature measured with a **standard thermometer**.

9.2.2 Procedure

1. Remove the sensor from the flow cell. Place it in an insulated container of water along with a **calibrated thermometer.** Submerge at least the bottom two inches of the sensor.
2. Allow the sensor to reach thermal equilibrium. The time constant for the chlorine sensor is about 5 min., so it may take as long as 30 min for equilibration.
3. Press MENU. The main menu screen appears. The cursor will be on Calibrate. Press ENTER.

Calibrate
Sensor 1
Sensor 2
Output 1
Output 2

4. Choose the sensor you wish to calibrate. **Sensor 2** appears only if you are using a dual input analyzer.

S1 Calibration
Total Chlorine
Temperature

5. Choose **Temperature**.

S1 Calibration
+ 25.0°C

6. Change the display to match the temperature read from the calibrated thermometer. Press ENTER.

   If the present temperature is more than 5ºC different from the value entered, an error message appears. To force the analyzer to accept the calibration, choose **Yes**. To repeat the calibration, choose **No**. For troubleshooting assistance, see Section 11.5.7.

7. To return to the main display, press MENU then EXIT.

9.3 CALIBRATING TOTAL CHLORINE

9.3.1 Purpose

The continuous determination of total chlorine requires two steps. See Figure 9-1. First, the sample flows into a conditioning system (the Model TCL) where it is treated with acetic acid (vinegar) and potassium iodide. The acid lowers the pH, which allows total chlorine in the sample to quantitatively oxidize the iodide to iodine. The treated sample then flows to the sensor. The sensor is a membrane-covered amperometric sensor, whose output is proportional to the concentration of iodine. Because the concentration of iodine is also proportional to the concentration of total chlorine, the analyzer can be calibrated to read total chlorine.

Figure 9-2 shows a typical calibration curve for a total chlorine sensor. Because the sensor really measures iodine, calibrating the sensor requires exposing it to a solution containing no iodine (zero standard) and to a solution containing a known amount of iodine (full-scale standard).

The zero standard is necessary because the sensor, even when no iodine is present, generates a small current called the residual or zero current. The analyzer compensates for the residual current by subtracting it from the measured current before converting the result to a total chlorine value. New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced. Deionized water is a good zero standard.

Do not zero the sensor by leaving it in the TCL flow cell and turning off reagent injection. Even though no iodine is present, the current measured under these conditions is **not** the zero current. Instead, it is the slight response of the sensor to total chlorine in the sample. **Always use deionized water for zeroing the sensor.**

The purpose of the full-scale standard is to establish the slope of the calibration curve. Because stable total chlorine standards do not exist, the sensor must be calibrated against a test run on a grab sample of the process liquid. Several manufacturers offer portable test kits for this purpose. Observe the following precautions when taking and testing the grab sample.

- Take the grab sample from a point as close as possible to the inlet of the TCL sample conditioning system.
- Total chlorine solutions are unstable. Run the test immediately after taking the sample. Try to calibrate the sensor when the chlorine concentration is at the upper end of the normal operating range.

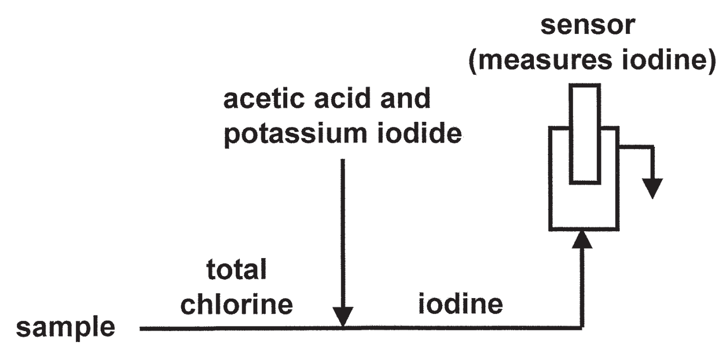


FIGURE 9-1. Determination of Total Chlorine

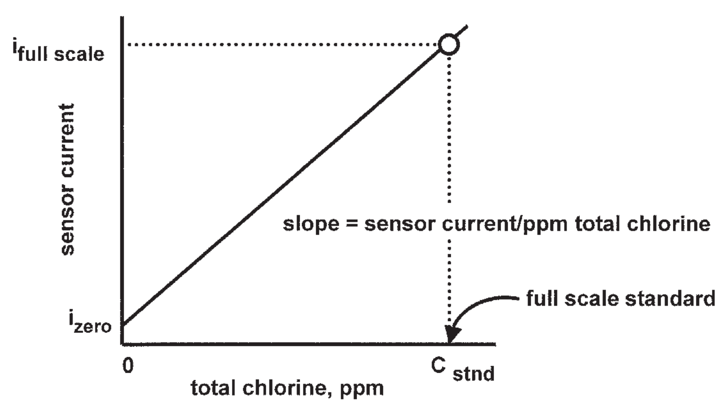


FIGURE 9-2. Sensor Current as a Function of Total Chlorine Concentration

9.3.2 Procedure — Zeroing the Sensor

1. Place the sensor in a beaker of deionized water. Be sure no air bubbles are trapped against the membrane.

2. Observe the sensor current. The current will drop rapidly at first and then gradually reach a stable zero value. To monitor the sensor current, press the DIAG key. Move the cursor to the chlorine sensor and press ENTER. The input current is the first line in the display. Note the units: nA is nanoamps, uA is microamps. Typical zero current for a 499ACL-02 sensor is -10 to +50 nA.

   A new sensor or a sensor in which the electrolyte solution has been replaced may require several hours (occasionally as long as overnight) to reach a minimum zero current. DO NOT START THE ZERO ROUTINE UNTIL THE SENSOR HAS BEEN IN THE ZERO SOLUTION FOR AT LEAST TWO HOURS.

3. Press MENU. The main menu screen appears. The cursor will be on **Calibrate**. Press ENTER.

Calibrate
Sensor 1
Sensor 2
Output 1
Output 2

4. Choose the sensor you wish to calibrate. **Sensor 2** appears only if you have a dual input 1056 analyzer.

S1 Calibration
Total Chlorine
Temperature

5. Choose **Total Chlorine**.

S1 Calibration
Zero Cal
In Process Cal

6. Choose **Zero Cal**. The analyzer will automatically start the zero calibration

S1 Zero Cal
Sensor zero done

7. If the zero calibration was successful, the screen at left appears.

S1 Possible
Error, Proceed?
No
Yes

If the zero current is moderately larger than expected, an error message appears. To force the analyzer to accept the zero current, choose **Yes**. To repeat the calibration, choose **No**. For troubleshooting assistance, see Section 11.5.

S1 Zero Cal
Sensor zero failed

Press Exit

If the zero current is much larger than expected, the zero calibration failure screen appears. The analyzer will not update the zero current. For troubleshooting assistance, see Section 11.5.

8. To return to the main display, press MENU then EXIT.

9.3.3 Procedure — Calibrating the sensor

1. If the sensor was just zeroed, place the sensor back in the flow cell. Confirm that excess sample is flowing down the inside tube of the overflow sampler. Also, verify that reagent is being delivered to the sample and that the air pump is working.
2. Adjust the chlorine concentration until it is near the upper end of the control range. Wait until the analyzer reading is stable before starting the calibration. When the TCL is first started up or when a new sensor is put in service, allow at least 30 minutes for the reading to stabilize.
3. Press MENU. The main menu screen appears. The cursor will be on **Calibrate**. Press ENTER.
4. Choose the sensor you wish to calibrate. **Sensor 2** appears only if you have a dual input 1056 analyzer.

Calibrate?
Sensor 1
Sensor 2
Output 1
Output 2

5. Choose **Total Chlorine.**

S1 Calibration
Total Chlorine
Temperature

6. Choose **In Process Ca**l

S1 Calibration
Zero Cal
In Process Cal

7. Follow the screen prompts: Once the reading is stable, press ENTER. Take the sample and press ENTER. At this point, the analyzer will store the present sensor current and temperature and use those values in the calibration.

   Determine the total chlorine concentration in the sample and enter the value in the screen shown at left. See Section 9.3.1 for sampling and testing precautions.

S1 Enter Value
10.00 ppm

8. If the calibration is successful, the live reading will change to the value entered in step 7 and the display will return to the screen in step 6.

   If the sensitivity is too far outside the range of expected values, the calibration error screen shown at left will appear. The analyzer will not update the calibration. For troubleshooting assistance, see Section 11.5.

S1 InProcess Cal
Calibration Error
Press Exit

9. To return to the main display, press MENU then EXIT.

9.4 CALIBRATING ANALOG OUTPUTS

9.4.1 Purpose

Although the analyzer analog outputs are calibrated at the factory, they can be trimmed in the field to match the reading from a standard milliammeter. Both the low (0 or 4 mA) and high (20 mA) outputs can be trimmed.

9.4.2 Procedure

1. Connect a calibrated milliammeter across the output you wish to calibrate. If a load is already connected to the output, disconnect the load. Do not put the milliameter in parallel with the load.
2. Press MENU. The main menu screen appears. The cursor will be on **Calibrate**. Press ENTER.
3. Choose the output you wish to calibrate.

Calibrate?
Sensor 1
Sensor 2
Output 1
Output 2

4. The analyzer will simulate the low output current. Change the value in the display to match the reading from the milliammeter.

4 mA Output 1
Cal Meter:
04.000 mA

5. The analyzer will simulate the 20 mA output current. Change the value in the display to match the reading from the milliammeter.

20 mA Output 1
Cal Meter:
20.000 mA

Output 1
Trim Complete

6. If the calibration was successful, the screen at left will appear.

7. If the user entered value is more that ±1 mA different from the nominal value, a possible error screen will appear. To force the analyzer to accept the calibration, choose **Yes**.

8. To return to the main display, press MENU then EXIT.

SECTION 10. MAINTENANCE

10.1 ANALYZER

The Model 1056 analyzer used with the TCL needs little routine maintenance.

Clean the analyzer case and front panel by wiping with a clean soft cloth dampened with water ONLY. Do not use solvents, like alcohol, that might cause a buildup of static charge.

The chlorine sensor circuit board (PN 24203-01) is replaceable. If you have a dual input Model 1056 analyzer, consult the Model 1056 instruction manual for the part number of the other board.

To replace the board

1. Turn off power to the analyzer.
2. Loosen the four screws holding the front panel in place and let the front panel drop down.
3. Loosen the gland fitting and carefully push the sensor cable up through the fitting as you pull out the circuit board.
4. Once you have access to the terminal strip, disconnect the sensor.
5. Unplug the sensor board from the main board. See Figure 10.1.
6. Slide the replacement board partially into the board slot. Plug the sensor board into the main board and reattach the sensor wires.
7. Carefully pull the sensor cable through the gland fitting as you push the sensor board back into the enclosure.
8. Close the front panel.
9. Turn on power.

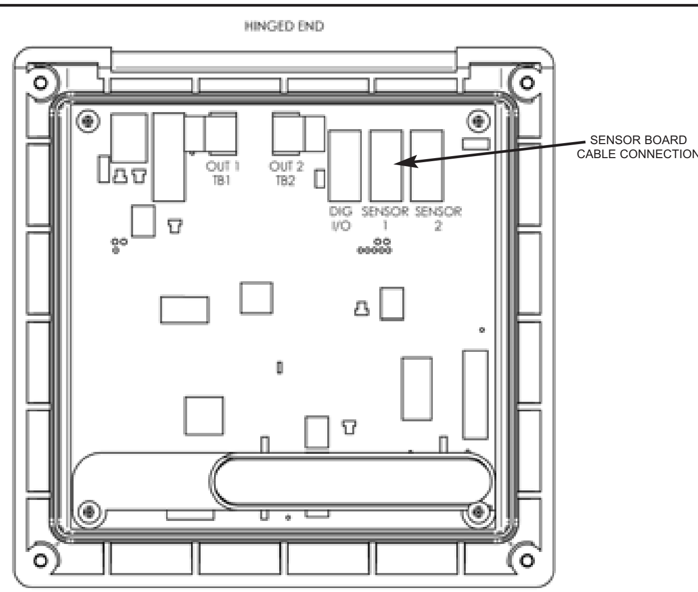


FIGURE 10-1. Sensor board connections.

10.2 TOTAL CHLORINE SENSOR

10.2.1 General

When used in clean water, the total chlorine sensor requires little maintenance. Generally, the sensor needs maintenance when the response becomes sluggish or noisy or when readings drift follow calibration. Maintenance frequency is best determined by experience. If the sensor is used in potable water, expect to clean the membrane every month and replace the membrane and electrolyte solution every three months. Sensors used in dirty water require more frequent maintenance and calibration. However, if experience shows the sensor is holding calibration and not drifting appreciably between calibration intervals, the maintenance interval can be extended.

10.2.2 Cleaning the membrane.

Keep the membrane clean. Clean the membrane with water sprayed from a wash bottle. Use a soft tissue to **gently** wipe the membrane.

10.2.3 Replacing the membrane.

1. Hold the sensor with the membrane facing up.
2. Unscrew membrane retainer. Remove the membrane assembly and O-ring. See Figure 10-2.
3. Inspect the cathode. If it is tarnished, clean it by gently rubbing in the direction of the existing scratches (do not use a circular motion) with 400-600 grit silicon carbide finishing paper. Rinse the cathode thoroughly with water.
4. Prepare a new membrane. Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up. Fill the cup with electrolyte solution. Set aside.
5. Put a new O-ring in the groove.
6 Place a drop of electrolyte solution on the cathode. Invert the membrane assembly and place it over the cathode stem.
7. Screw the membrane retainer back in place.
8. Hold the sensor with the membrane pointing down. Shake the sensor a few times, as though shaking down a clinical thermometer.

10.2.4 Replacing the membrane and electrolyte solution.

CAUTION

Fill solution may cause irritation.
Avoid contact with skin and eyes.
May be harmful if swallowed.

1. Unscrew the membrane retainer and remove the membrane assembly and O-ring. See Figure 10-2.
2. Hold the sensor over a container with the cathode pointing down.
3. Remove the fill plug and allow the electrolyte solution to drain out.
4. Wrap the plug with two turns of pipe tape and set aside. Remove old tape first.
5. Prepare a new membrane. Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up. Fill the cup with electrolyte solution. Set aside.
6. Hold the sensor at about a 45-degree angle with the cathode end pointing up. Add electrolyte solution (PN 9210438) through the fill hole until the liquid overflows. Tap the sensor near the threads to release trapped air bubbles. Add more electrolyte solution if necessary.
7. Place the fill plug in the electrolyte port and begin screwing it in. After several threads have engaged, rotate the sensor so that the cathode is pointing up and continue tightening the fill plug. Do not overtighten.
8. Place a new O-ring in the groove around the cathode post. Cover the holes at the base of the cathode stem with several drops of electrolyte solution.
9. Insert a small **blunt** probe, like a toothpick with the end cut off, through the pressure equalizing port. See Figure 10-2.

NOTE

Do not use a sharp probe. It will puncture the bladder and destroy the sensor.

Gently press the probe against the bladder several times to force liquid through the holes at the base of the cathode stem. Keep pressing the bladder until no air bubbles can be seen leaving the holes. Be sure the holes remain covered with electrolyte solution.

10. Place a drop of electrolyte solution on the cathode, then place the membrane assembly over the cathode. Screw the membrane retainer in place.
11. The sensor may require several hours operating at the polarizing voltage to equilibrate after the electrolyte solution has been replenished.

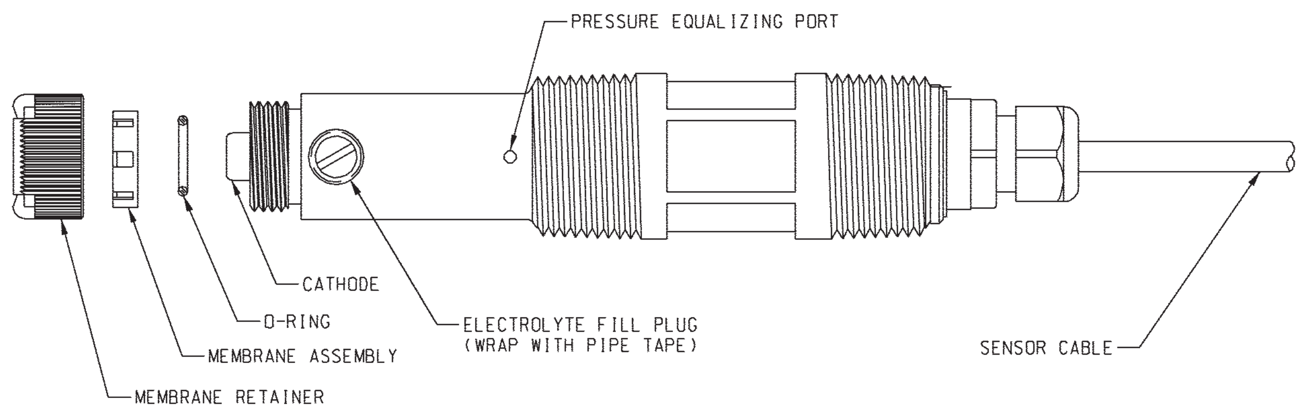


FIGURE 10-2. Sensor Parts

TABLE 10-1. Spare Parts

33523-00	Electrolyte Fill Plug
9550094	O-Ring, Viton 2-014
33521-00	Membrane Retainer
23501-02	Total Chlorine Membrane Assembly: includes one membrane assembly and one O-ring
23502-02	Total Chlorine Membrane Kit: includes 3 membrane assemblies and 3 O-rings
9210438	Total Chlorine Sensor Fill Solution, 4 oz (120 mL)

10.3 SAMPLE CONDITIONING SYSTEM

10.3.1 Reagent

The sample conditioning reagent lasts about 2 months. Before putting fresh reagent in the carboy, discard any small amount of remaining reagent. To prepare the reagent refer to the procedure in Section 5.1. See Table 10-2 for ordering information.

10.3.2 Sample and reagent tubing.

Periodically inspect sample and reagent tubing for cracks and leaks. Replace tubing if it is damaged.

After a period of time, the sample tubing may become plugged with suspended matter. The tubing is flexible and difficult to clean mechanically. Plugged sample tubing is best replaced.

Replacement tubing kits are available. See Table 10-2 for part numbers.

To replace reagent tubing:

1. Reagent tubing is shown in Figure 10-2.
2. Turn off sample and reagent pumps.
3. Luer fittings connect the reagent tubing to the pump. Disconnect the tubing by turning the fitting in the direction of the arrows shown in Figure 10-5.
4. Disconnect the other end of the suction tubing from the barb on the reagent inlet fitting in the bottom of the enclosure. Disconnect the other end of discharge tubing from the reagent injection tee.
5. Install the replacement tubing. Note that the discharge tubing is longer than the suction tubing.

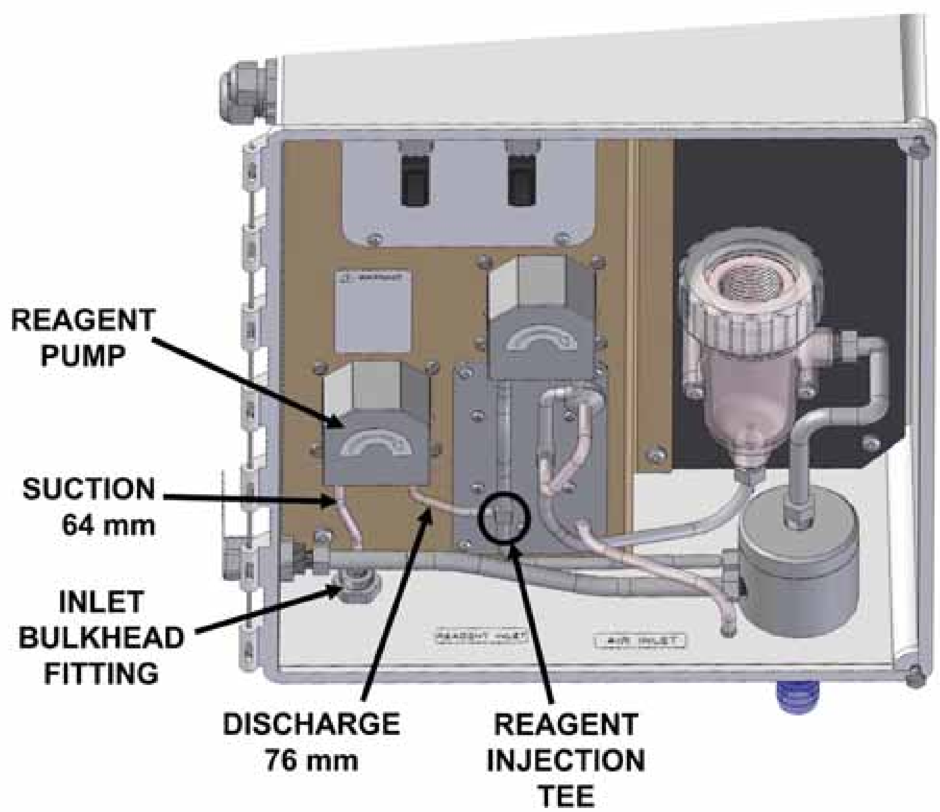


FIGURE 10-3. Replacing Reagent Tubing

To replace sample tubing:

1. Sample tubing is shown in Figure 10-4.
2. Turn off the sample and reagent pumps.
3. Luer fittings connect the sample tubing to the pump. Disconnect the tubing by turning the fitting in the direction of the arrows shown in Figure 10-5.
4. Disconnect the other end of the sample pump suction tubing from the overflow sampler. Pull the reagent injection tube off the reagent injection tee.
5. Disconnect the other end of the sample pump discharge tubing from the flow cell. Pull the air injection tube off the air injection tee.
6. Disconnect the sample inlet and drain tubing.
7. Install the replacement sample pump suction and discharge tubing assemblies. The assemblies look similar. To tell the difference, note the air injection tee in the discharge tubing assembly has a larger diameter barb than the reagent injection tee in the suction tubing assembly.
8. Install replacement sample inlet and drain tubing. The sample inlet tubing is longer than the drain tubing.

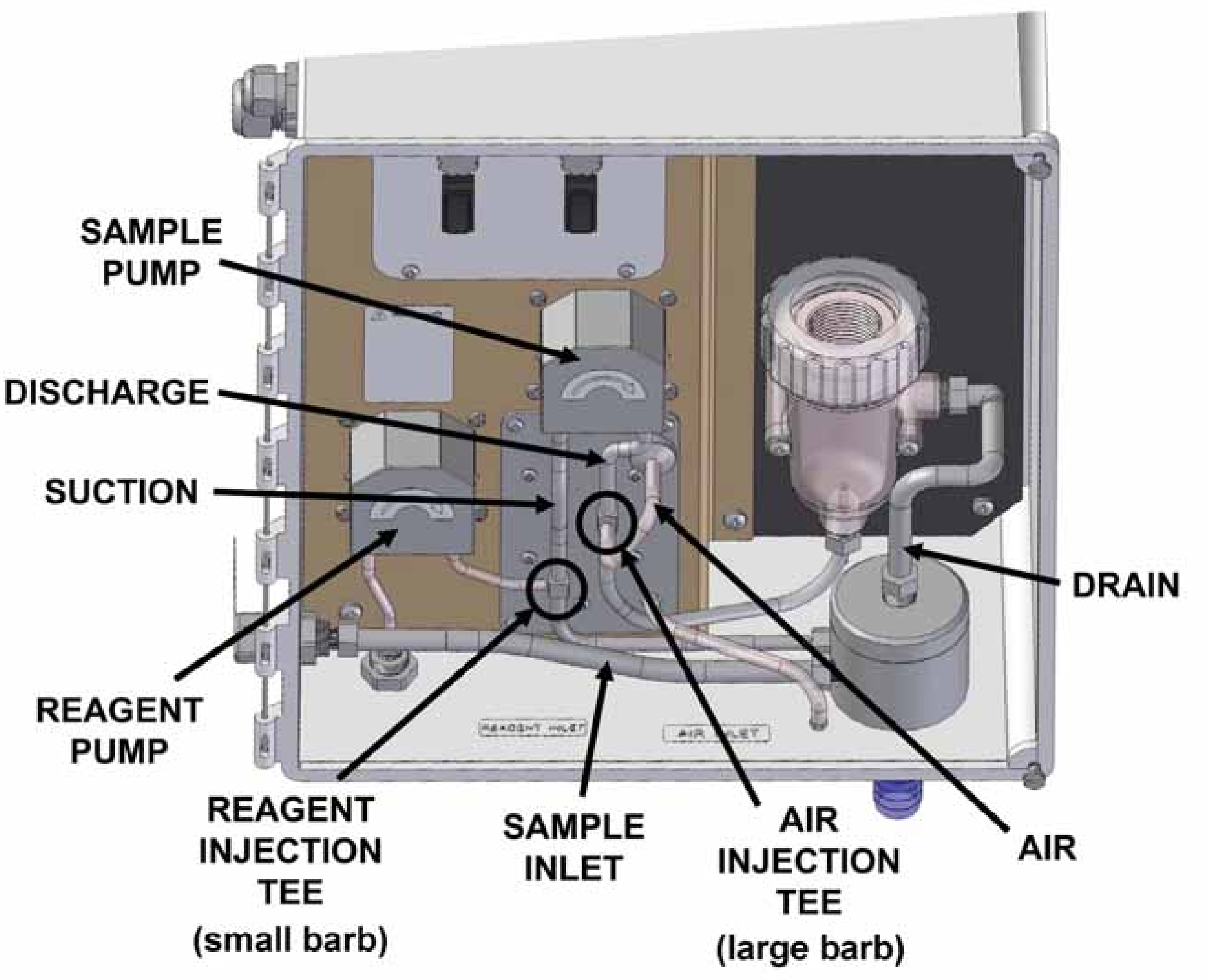


FIGURE 10-4. Replacing Sample Tubing

10.3.3 Peristaltic pump tubing.

The expected life of the peristaltic pump tubing is one year.

To replace pump tubing:

1. Turn off the sample and reagent pumps.
2. The reagent and sample tubing is connected to the pump tubing with luer fittings. See Figure 10-5. Disconnect the fittings from the pump by turning the fitting in the direction of the arrow.

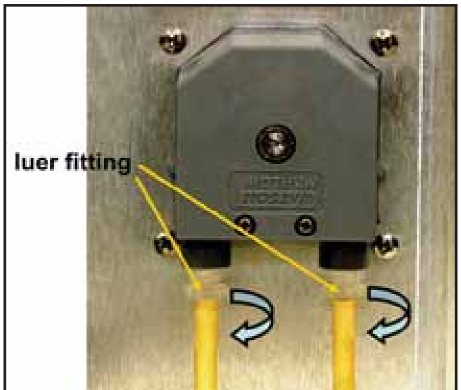


FIGURE 10-5.

3. Using your thumb and forefinger gently pinch the sides of the pump cover. Slide the cover upwards to remove it. See Figure 10-6.

FIGURE 10-6.

4. Using your thumb as shown in Figure 10-7, push the tubing fitting straight outward until the fitting slides out of the socket. Repeat the process for the other fitting.
5. Remove and discard the pump tubing.

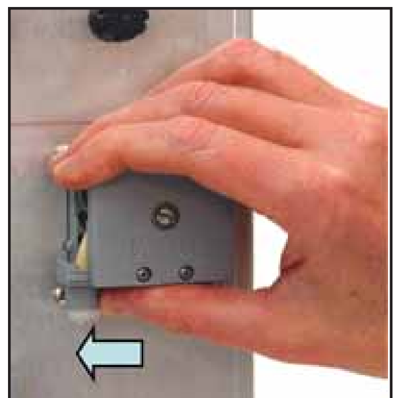


FIGURE 10-7.

6. Insert the new tubing one end at a time. Tongues on the sides of the gray fittings at the ends of the tube fit into receiving grooves in the pump casing. See Figure 10-8. Push the fitting into place until it clicks. Gently stretch the tubing over the rollers and insert the other fitting into the receiving socket on the other side of the pump.

FIGURE 10-8.

7. Replace the pump cover.
   a. Place the cover on the pump casing. See Figure 10-9.

FIGURE 10-9.

   b. Be sure the pins at the bottom of the cover (Figure 10-10) ride on the tracks in the pump casing.

FIGURE 10-10.

   c. The position of the track is outlined in Figure 10-11. The pins on the pump cover must ride in these tracks as the cover is pushed into place. Gently squeeze the ends of the cover to guide the pins.

FIGURE 10-11.

   d. Push down until the cover snaps into place.

8. Reconnect the tubing.

10.3.4 Replacing the air pump

WARNING

HAZARDOUS VOLTAGE

CAN CAUSE SEVERE INJURY OR DEATH.

DISCONNECT POWER BEFORE SERVICING.

9241136/B

1. Disconnect power to the analyzer.
2. Refer to Figure 10-12. Disconnect the reagent and air injection tubes. Disconnect the suction and discharge tubing by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed fitting in the bottom of the enclosure.
3. Remove the four screws (circled in Figure 10-13) holding the air pump access panel. Pull out the pump and panel.
4. Disconnect the air inlet and outlet tubing from the air pump. See Figure 10-14.
5. Remove the five screws (surrounded by squares in Figure 10-13) holding the air pump to the access panel.
6. Remove the four screws holding the wiring access panel.
7. Disconnect the air pump power wires from the terminal strip. See Figure 10-15. Discard the old air pump.
8. Remove the five screws holding the rubber base of the replacement air pump to the body.
9. Using the five screws removed in step 6, attach the replacement air pump to the access panel.
10. Connect the air pump power wires to the terminal strip.
11. Replace the wiring access panel.
12. Connect the air inlet and outlet tubing to the air pump. See Figure 10-14. The conical end of the check valve points in the direction of the air flow.
13. Replace the air pump access panel.
14. Connect the sample pump tubing to the pump. Connect the reagent and air injection tubing. Connect the air inlet tubing to the barbed fitting at the bottom of the enclosure.

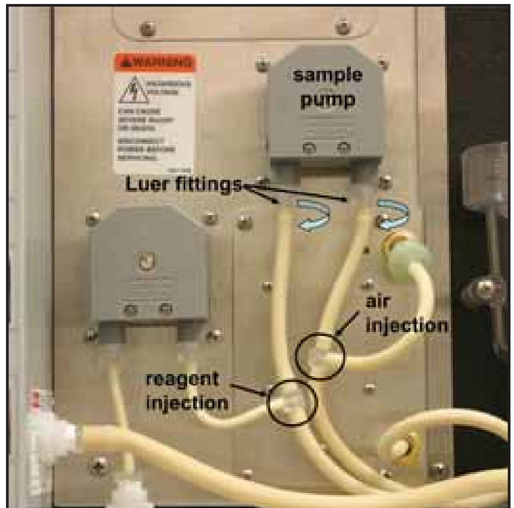


FIGURE 10-12.

FIGURE 10-13.

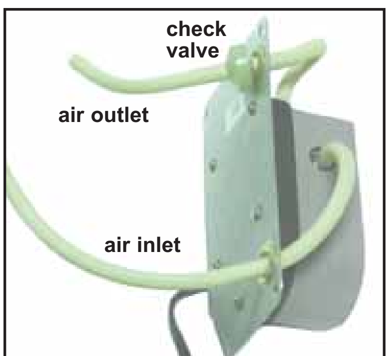


FIGURE 10-14.

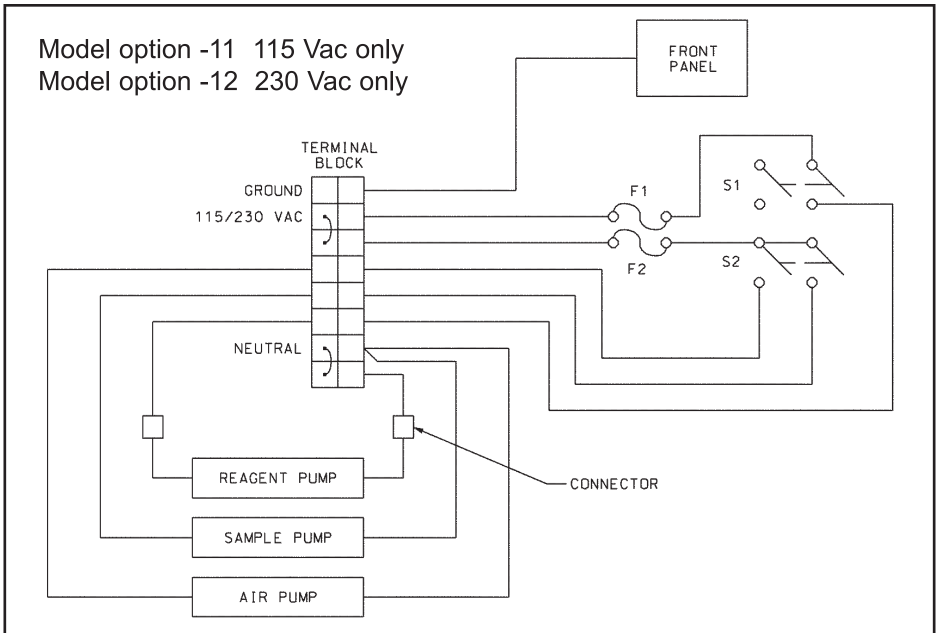


FIGURE 10-15.

10.3.5 Replacing the air pump diaphragm and check valves.

⚠ WARNING

HAZARDOUS VOLTAGE

CAN CAUSE SEVERE INJURY OR DEATH.

DISCONNECT POWER BEFORE SERVICING.

9241136/B

1. Disconnect power to the analyzer.
2. Refer to Figure 10-12. Disconnect the reagent and air injection tubes. Disconnect the suction and discharge tubing by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed fitting in the bottom of the enclosure.
3. Remove the four screws (circled in Figure 10-13) holding the air pump access panel. Pull out the pump and panel.
4. Disconnect the air inlet and outlet tubing from the air pump. See Figure 10-14.
5. Remove the five screws (surrounded by squares in Figure 10-13) holding the air pump to the access panel.
6. Pull the rubber base off the pump.
7. Using needle nose pliers, remove the air inlet fitting from the side of the air pump. See Figure 10-16.
8. Slide the pump assembly out of the air pump body. See Figure 10-17.
9. Following instructions on the package (PN 9160518), replace the diaphragm and check valves.
10. Slide the pump assembly back into the pump body and replace the barbed inlet fitting.
11. Replace the rubber base and screw the pump access panel back onto the air pump.
12. Connect the air inlet and outlet tubing to the air pump. See Figure 10-14. The conical end of the check valve points in the direction of the air flow.
13. Replace the air pump access panel.
14. Connect the sample pump tubing to the pump. Connect the reagent and air injection tubing. Connect the air inlet tubing to the barbed fitting at the bottom of the enclosure.

FIGURE 10-16.

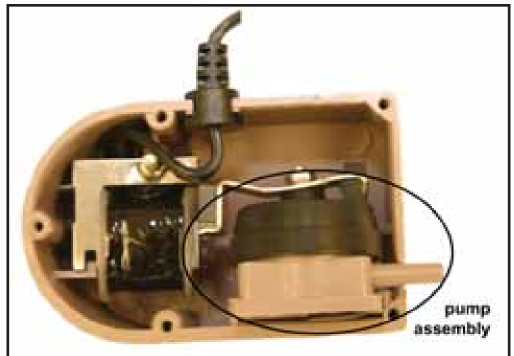


FIGURE 10-17.

TABLE 10-2. Replacement Parts and Reagent for Sample Conditioning System

PN	Description
24134-00	Air pump, 115 Vac, 60 Hz
24134-01	Air pump, 230 Vac, 50 Hz
9160578	Air pump repair kit
9322052	Check valve for air injection line
24153-00	Carboy for reagent, 5 gal/19 L, includes cap
9100204	Fuse, 0.25 A, 250 V, 3AG, slow blow for option -11 (115 Vac)
9100132	Fuse, 0.125 A, 250 V, 3AG, slow blow for option -12 (230 Vac)
9380094	Reagent pump, 115 Vac, 50/60 Hz
9380095	Reagent pump, 230 Vac, 50/60 Hz
9380091	Reagent pump replacement tubing
24151-00	Reagent tubing replacement kit (see Section 9.3.2)
24135-00	Reagent uptake tubing, 6 ft (1.8 m), includes weight
9380090	Sample pump, 115 Vac, 50/60 Hz
9380093	Sample pump, 230 Vac, 50/60 Hz
9380092	Sample pump replacement tubing
24152-00	Sample tubing replacement kit (includes tees, see Section 9.3.2)

PN	Description
24165-00	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 25 g potassium iodide
24165-01	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 50 g potassium iodide
24164-00	Potassium iodide, 25 g, sufficient for 5 gallons (19 L) of vinegar (for 0-5 ppm total chlorine)
24164-01	Potassium iodide, 50 g, sufficient for 5 gallons (19 L) of vinegar (for 0-10 ppm total chlorine)

SECTION 11.
TROUBLESHOOTING

11.1 OVERVIEW

The analyzer continuously monitors itself and the sensor(s) for problems. When the analyzer identifies a problem, the word **warning** or **fault** appears intermittently in the lower line of the main display. When the **fault** or **warning** message appears, press the DIAG (diagnostic) key for more information. See Section 11.2.

A **warning** means the instrument or sensor is usable, but steps should be taken as soon as possible to correct the condition causing the warning.

A **fault** means the measurement is seriously in error and is not to be trusted. A fault condition might also mean that the analyzer has failed. Fault conditions must be corrected immediately. When a fault occurs the analog output goes to 22.00 mA or to the value programmed in Section 7.3.2.

The analyzer also displays warning messages if a calibration is seriously in error. For more information see Section 11.3.

11.2 USING THE DIAGNOSTIC FEATURE

Diagnostic
Faults
Warnings
Sensor 1
Sensor 2

1. To read diagnostic messages, press DIAG. The screen at left appears. To display fault messages, select **Fault**. To display **Warning** messages select warning. To read measurement information about the sensor(s) including raw sensor signal and calibration data, choose the desired sensor and press ENTER.

Faults
S1 RTD Open
S2 RTD Open

2. If you choose **Fault** or **Warning**, a screen like the one shown at left appears. **S1** means sensor 1. **S2** means sensor 2. For additional troubleshooting information, select the desired message and press ENTER. For more information, see Section 11.3.

3. To return to the main display, press MENU then EXIT

11.3 TROUBLESHOOTING WHEN A FAULT MESSAGE IS SHOWING

Fault message	Explanation	Section
Main Board CPU Error	Main board software is corrupted	11.3.1
Main Board Factory Data	Main board factory eeprom data is corrupted	11.3.1
Main Board User Data	Main board user eeprom data is corrupted	11.3.1
Sensor Hardware Error	Missing or bad hardware component	11.3.2
Sensor Board Unknown	Analyzer does not recognize sensor board	11.3.3
Sensor HW-SW Mismatch	Sensor board hardware and software do not match	11.3.3
Sensor Incompatible	Sensor board software is not supported by main board software	11.3.4
Sensor Not Communicating	Sensor board is not communicating with main board	11.3.3
Sensor CPU Error	Sensor board software is corrupted	11.3.5
Sensor RTD Open	Temperature measuring circuit is open	11.3.6
S1 Not Detected	No sensor board is connected to sensor 1 terminal	11.3.7
Sensor Factory Data	Sensor board factory eeprom data is corrupted	11.3.8
Sensor EEPROM Write Error	Bad CPU on the sensor board	11.3.8
Sensor User Data	Sensor board user eeprom data is corrupted	11.3.8
Sensor ADC Error	Bad component on the sensor board	11.3.9
Sensor RTD Out of Range	RTD is improperly wired or has failed	11.3.10

11.3.1 Main Board CPU, Main Board Factory Data, and Main Board User Data Errors.
These error messages mean the main board software is corrupted or the eeprom data on the main board is corrupted.

1. Cycle the power off then on.
2. If cycling the power does not help, call the factory. The main board must be replaced. To do this, the analyzer must be returned to the factory.
3. If cycling the power does not help **and the fault message was Main Board User Data**, reset the analyzer to factory default. See section 7.8. Re-enter user settings and repeat calibration.

11.3.2 Hardware Error.
Hardware error means there is a missing or bad hardware component on the sensor board. The board must be replaced.

11.3.3 Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating.
These error messages mean the main board either does not recognize the sensor board or the sensor board and main board are no longer communicating.

1. Verify that the ribbon cable connecting the main board (on the inside of the front panel) and the sensor board are properly seated. Inspect the connecting cable for obvious tears or breaks.
2. If the ribbon cable is properly seated and appears undamaged, the sensor board should be replaced.

11.3.4 Sensor Incompatible

This error message means that the sensor board software is not supported by the main board software. Either the sensor board or the main board software is too old.

Replace the main board with one compatible with the sensor board. Call the factory for assistance. You will be asked for the main and sensor board software revision numbers. To read the main board software revision, press the DIAG key and scroll down until **Instr SW Ver** is showing. To view the sensor board software revision, press the DIAG key, choose the appropriate sensor, and scroll down until **Board SW Ver** is showing. The main board can be replaced only at the factory.

11.3.5 Sensor CPU Error

This message means the sensor board software is corrupted.

1. Cycle the power off then on.
2. If cycling the power does not help, call the factory. The sensor board must be replaced.

11.3.6 Sensor RTD Open

There is an open circuit in the sensor RTD (resistance temperature device) or wiring.

1. It the sensor is being installed for the first time, check the wiring connections. See Section 4.3.
2. Disconnect the sensor from the analyzer and measure the resistance between the RTD in and return wires. See Figure 4.4 or 4.5. If there is an open circuit, replace the sensor.
3. If there is no open, check the analyzer. See Section 11.5.

11.3.7 Sensor 1 Not Detected

The ribbon cable from sensor 1 (chlorine) board must be plugged into sensor 1 plug. See Figure 10-1 for the location of the sensor board connectors.

1. Confirm that the ribbon cable connecting sensor 1 (chlorine) board to the main board is plugged into Sensor 1 connector on the main board.
2. Confirm that the ribbon cable is seated at both ends.

11.3.8 Sensor Factory Data, Sensor Board User Data, and Sensor EEPROM Write Error

These messages mean factory eeprom data or user eeprom data on the sensor board is corrupted or the CPU on the sensor board is bad.

1. Cycle power off then on.
2. Replace the sensor board.

11.3.9 Sensor ADC Error

There is a bad component on the sensor board. The sensor board must be replaced.

11.3.10 Sensor RTD Out of Range

499ACL-02 chlorine sensor contains a Pt 100 RTD (resistance temperature device) for measuring temperature. If the measured resistance is outside the expected range, the analyzer will display the out of range error message.

1. Check wiring connections.
2. Disconnect the sensor from the analyzer and use an ohmmeter to check the resistance across the RTD in and return leads. See Figure 4.4 or 4.5. The resistance should be about 110 Ω. If there is an open or short circuit, or if the resistance is more than about 5% different from 110 Ω, the sensor has failed and should be replaced.
3. If there is no open or short, check the analyzer. See Section 11.7.2.

11.4 TROUBLESHOOTING WHEN A WARNING MESSAGE IS SHOWING

Warning message	Explanation	Section
Sensor Need Factory Cal	The sensor board was not calibrated at the factory.	11.4.1
Sensor Negative Reading	The chlorine reading is less than -0.5 ppm.	11.4.2
Sensor RTD Sense Open	RTD sensor line is broken or not connected	11.4.3
Sensor Temperature High	Temperature is greater than 155ºC (311ºF)	11.4.4
Sensor Temperature Low	Temperature is less than -20ºC (-4ºF)	11.4.5

11.4.1 Sensor Need Factory Cal
The sensor board was improperly calibrated at the factory. Call the factory for assistance.

11.4.2 Sensor Negative Reading
The analyzer converts the raw current from the sensor to ppm chlorine by subtracting the zero current from the raw current and multiplying the result by a conversion factor. If the zero current is larger than the raw current, the result will be negative.

1. Check the zero current. It should be less than about 50 nA. If it is greater than 50 nA, repeat the zero step.
2. If the zero current is in the correct range, the negative reading might be the result of the raw current or the sensitivity being too low. A properly operating sensor should generate about 1000 nA for every 1 ppm of total chlorine. Recalibrate the sensor. If necessary, clean or replace the membrane and check the fill solution.
3. Replace the sensor.

11.4.3 Sensor RTD Sense Open
The analyzer measures temperature using a three-wire RTD. See Figure 11.3. The in and return leads are used to measure the resistance of the RTD. The third lead, called the sense line, is connected to the return lead at the sensor. The sense line allows the analyzer to correct for the resistance of the in and return leads and to compensate for changes in wire resistance caused by changes in ambient temperature.

1. Check wiring. See Figure 4.4 or 4.5.
2. Disconnect the sense and return wires and check the resistance between them. It should be less than 1Ω. See Figure 4.4 or 4.5.
3. Even though the sense line is open, the sensor is still usable. Use a wire jumper to connect the sense and return terminals on the sensor terminal strip. The temperature reading will no longer be corrected for the lead resistance, nor will the analyzer be able to compensate for changes in ambient temperature. The error could be several ºC or more.
4. Replace the sensor.

11.4.4 Sensor Temperature High or Low
The sensor RTD is most likely miswired.

1. Check wiring connections.
2. Disconnect the RTD in and return leads and check the resistance between them. See Figure 4.4 or 4.5. The resistance should be close to the values given in Section 11.5.
3. Replace sensor.

11.5 TROUBLESHOOTING WHEN NO ERROR MESSAGE IS SHOWING

Problem	See Section
Zero current was accepted, but the current is outside the range -10 to 50 nA	11.5.1
Error or warning message appears while zeroing the sensor (zero current is too high)	11.5.1
Zero current is unstable	11.5.2
Sensor can be calibrated, but current is low	11.5.3
Process readings are erratic or wander	11.5.4
Readings drift	11.5.5
Readings are too high	11.5.6
Readings are too low	11.5.3
Calibration temperature more than 3°C different from standard thermometer	11.5.7
Current output is too low	11.5.8
Alarm relays do not operate when setpoint is exceeded or do not release when reading is below setpoint	11.5.9

15.5.1 Zero current is too high

1. Is the sensor properly wired to the analyzer? See Section 4.3.
2. Is the zero solution chlorine free? Take a sample of the zero solution and test it for total chlorine. The concentration should be less than 0.05 ppm. Avoid using tap water for zeroing the sensor. Even though the tap water contains no iodine, chlorine oxidants present in the tap water may produce a sensor current as high as 100 nA.
3. Has adequate time been allowed for the sensor to reach a minimum stable zero current? It may take several hours, sometimes as long as overnight, for a new sensor to stabilize.
4. Is the sensor fill solution fresh? An old, discolored fill solution may produce a high zero current.
5. Is the membrane damaged? Inspect the membrane and replace it if necessary.

11.5.2 Zero current is unstable

1. Is the sensor properly wired to the analyzer? See Section 4.3. Verify that all connections are tight.
2. Readings can be erratic when a new sensor is first placed in service. Readings usually stabilize over about an hour.
3. Is the space between the membrane and cathode filled with electrolyte solution and is the flow path between the electrolyte reservoir and membrane clear? Often the flow of electrolyte can be started by simply holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.

   If shaking does not work, try clearing the holes around the cathode stem. Hold the sensor with the membrane end pointing up. Unscrew the membrane retainer and remove the membrane assembly. Use the end of a straightened paper clip to clear the holes at the base of the cathode stem.

   Verify the sensor is filled with electrolyte solution. Refer to Section 10.2.

11.5.3 Sensitivity is low or readings are low

1. Does the reagent carboy contain reagent? Is the reagent uptake tubing below the level of the reagent? Has potassium iodide been added to the acetic acid (vinegar) reagent?
2. Is there adequate flow to the overflow sampler? Excess sample should be flowing down the inside tube of the overflow sampler.
3. Does the reagent contain the correct amount of potassium iodide? See the table.

Expected range, ppm as Cl2	Amount of KI needed per 5 gallons of vinegar	Part number
0 – 5 ppm	25 grams	24164-00
0 – 10 ppm	50 grams	24164-01
0 – 20 ppm	2 x 50 grams	24164-01

4. Was the comparison or calibration sample tested as soon as it was taken? Chlorine solutions can be unstable. Test the sample immediately after collecting it. Avoid exposing the sample to sunlight.
5. Is the membrane fouled or coated? A dirty membrane inhibits diffusion of iodine through the membrane, reducing sensor current. Clean the membrane by rinsing it with a stream of water from a wash bottle. Wipe gently with a soft tissue.
6. Are the reagent and sample pumps running? If a pump is not running, check the fuse and replace it if necessary. See Table 10-2 for part numbers. If the fuse is okay, replace the pump.
7. Are all tube fittings tight? Pay particular attention to the luer fittings that connect the tubing to the pumps.
8. Does the pump tubing element need replacing? Remove the tubing from the pump and inspect it. If the tubing appears permanently pinched or deformed, replace the tubing. Refer to Section 10.3.3 for instructions on how to remove and replace the tubing elements. The expected life of a tubing element is about one year.
9. Is the sample flow to the sensor about 11 mL/min? If the sample flow is too low, the total chlorine reading will be low. If the flow is too high, the ratio between the sample flow and reagent flow will be too high, and there might be insufficient reagent to properly react with the total chlorine in the sample. To check sample flow…
    a. Turn off the reagent and sample pumps.
    b. Disconnect the luer fitting on the discharge of the sample pump. See **A** in Figure 11-1.
    c. Hold a small beaker under the discharge port.
    d. Start the sample pump and collect sample for two minutes.
    e. Measure the volume of sample collected in the beaker. After two minutes, the volume should be about 22 mL.
10. Is the reagent flow about 0.2 mL/min? If the reagent flow is too low, there might be insufficient acetic acid to lower the sample pH and insufficient potassium iodide to react with total chlorine in the sample. To check reagent flow…
    a. Turn off the reagent and sample pumps.
    b. Disconnect the reagent tubing at the injection tee. See **B** in Figure 11-1.
    c. Place the end of the tubing in a 5 mL graduated cylinder.
    d. Start the reagent pump and collect reagent for ten minutes.
    e. Note the volume of reagent collected in the graduated cylinder. After ten minutes the volume should be about 2 mL.

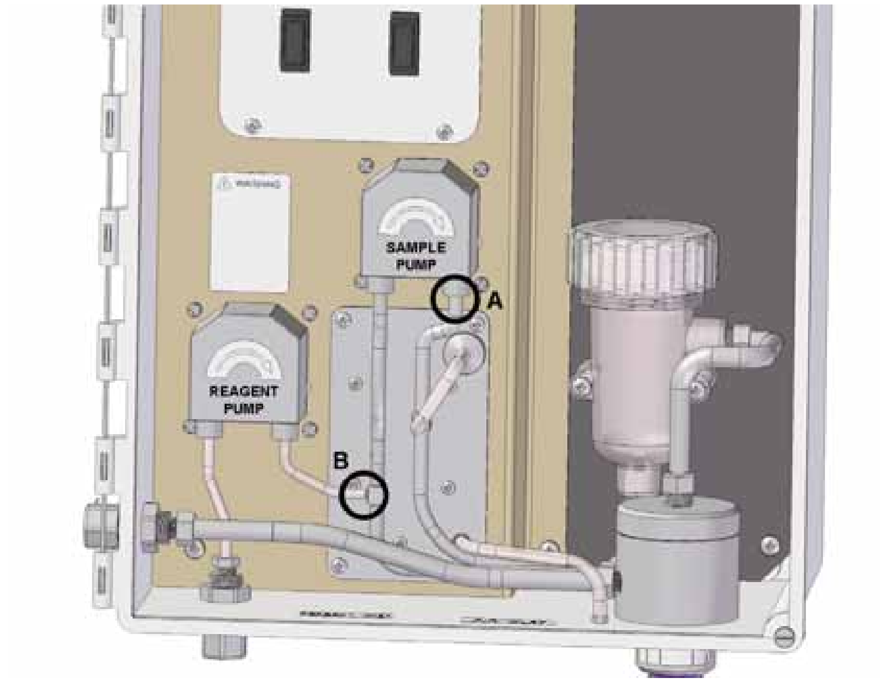


FIGURE 11-1. Disconnecting sample (A) and reagent (B) tubing prior to checking flow.

11.5.4 Process readings are erratic or wander

1. Is the sensor properly wired to the analyzer? See Section 4.3. Verify that all connections are tight.
2. Readings can be erratic when a new sensor is first placed in service. Readings usually stabilize after about an hour.
3. Is the air pump working? There should be a vigorous stream of bubbles in the flow cell. The bubbles help mix the sample and keep carbon dioxide bubbles off the membrane. Carbon dioxide forms when bicarbonate alkalinity in the sample reacts with acetic acid. The bubbles accumulate on the membrane and eventually break away, causing the total chlorine reading to wander.
4. Is the membrane damaged or loose? Replace the membrane if necessary.
5. Is the space between the membrane and cathode filled with electrolyte solution and is the flow path between the electrolyte reservoir and membrane clear? Refer to Section 11.5.2 step 3 for more information.

11.5.5 Readings drift

1. Is the sample temperature changing? Membrane permeability is a function of temperature. The time constant for the 499ACL-01 sensor is about five minutes. Therefore the reading may drift for a while after a sudden temperature change.
2. Is the membrane clean? For the sensor to work properly, iodine must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of iodine, resulting in a gradual downward drift in readings. The coating will also slow the response on the sensor to step changes. Clean the membrane by rinsing is with a stream of water from a wash bottle. Wipe the membrane with a soft tissue.
3. Is the sensor new or has it recently been serviced? New or rebuilt sensors may require several hours to stabilize.
4. Is the flow of sample past the sensor about 11 mL/min? See Section 11.5.3 step 9 for more information.
5. Is the reagent flow about 0.2 mL/min? See Section 11.5.3 step 10 for more information.

11.5.6 Readings are too high

1. Is the sample conditioning reagent clear and colorless? If the reagent is pale yellow, results will be high. The pale yellow color is caused by iodine, which comes from the reaction between atmospheric oxygen and potassium iodide. The reaction is catalyzed by sunlight. The purpose of the blue carboy is to protect the reagent from sunlight.
2. Is the sensor fill solution fresh? An old, discolored fill solution may produce a high reading.

11.5.7 Temperature measured by standard thermometer was more than 3°C different from analyzer.

1. Is the standard thermometer, RTD, or thermistor accurate? General purpose liquid-in-glass thermometers, particularly ones that have been mistreated, can have surprisingly large errors.
2. Is the temperature element in the sensor completely submerged in the liquid?
3. Is the standard temperature sensor submerged to the correct level?

11.5.8 Current Output Too Low.

Load resistance is too high. Maximum load is 550 Ω.

11.5.9 Alarm Relays Do Not Work

1. Verify the relays are properly wired.
2. Verify that deadband is correctly set. See Section 7.4.

11.6 SIMULATING INPUTS

To check the performance of the analyzer, use a decade box and 1.5V battery to simulate the current from the sensor. The battery, which opposes the polarizing voltage, is necessary to ensure that the sensor current has the correct sign.

1. Disconnect the anode and cathode leads from terminals 8 and 10 on TB1 and connect a decade box and 1.5V battery as shown in Figure 11-2. It is not necessary to disconnect the RTD leads.
2. Set the decade box to 1.4 MΩ.
3. Note the sensor current. It should be about 960 nA. The actual value depends on the voltage of the battery. To view the sensor current, go to the main display and press DIAG. Choose sensor 1. The input current is the second line in the display. Change the decade box resistance and verify that the correct current is shown. Calculate current from the equation:

$$\text{current (nA)} = \frac{V_{battery} - 250 \text{ (voltages in mV)}}{\text{resistance (M}\Omega\text{)}}$$

The voltage of a fresh 1.5 volt battery is about 1.6 volt (1600 mV).

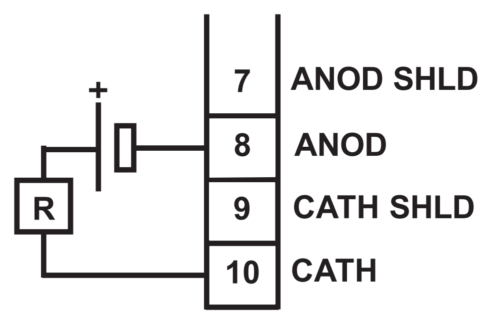


FIGURE 11-2. Simulating Chlorine

11.6 SIMULATING TEMPERATURE

11.6.1 General.

The Model 1056 accepts a Pt100 RTD. The Pt100 RTD is in a three-wire configuration. See Figure 11-3.

11.6.2 Simulating temperature

To simulate the temperature input, wire a decade box to the analyzer or junction box as shown in Figure 11-4.

To check the accuracy of the temperature measurement, set the resistor simulating the RTD to the values indicated in the table and note the temperature readings. The measured temperature might not agree with the value in the table. During sensor calibration an offset might have been applied to make the measured temperature agree with a standard thermometer. The offset is also applied to the simulated resistance. The analyzer is measuring temperature correctly if the difference between measured temperatures equals the difference between the values in the table to within ±0.1°C.

For example, start with a simulated resistance of 103.9 Ω, which corresponds to 10.0°C. Assume the offset from the sensor calibration was -0.3 Ω. Because of the offset, the analyzer calculates temperature using 103.6 Ω. The result is 9.2°C. Now change the resistance to 107.8 Ω, which corresponds to 20.0°C. The analyzer uses 107.5 Ω to calculate the temperature, so the display reads 19.2°C. Because the difference between the displayed temperatures (10.0°C) is the same as the difference between the simulated temperatures, the analyzer is working correctly.

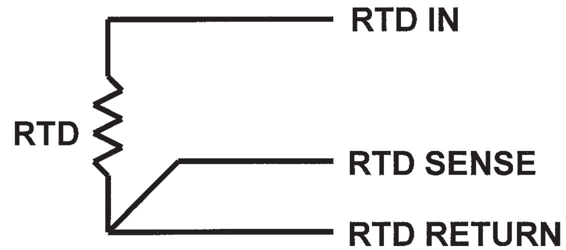


FIGURE 11-3. Three-Wire RTD Configuration.

Although only two wires are required to connect the RTD to the analyzer, using a third (and sometimes fourth) wire allows the analyzer to correct for the resistance of the lead wires and for changes in the lead wire resistance caused by temperature changes.

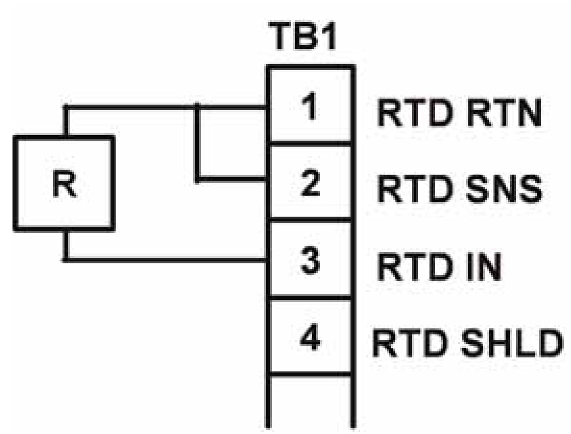


FIGURE 11-4. Simulating RTD Inputs.

Temp. (°C)	Pt 100 (Ω)
0	100.0
10	103.9
20	107.8
25	109.7
30	111.7
40	115.5
50	119.4
60	123.2
70	127.1
80	130.9
85	132.8
90	134.7
100	138.5

SECTION 12.
RETURN OF MATERIAL

12.1 GENERAL.

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Before returning a product for repair, call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

12.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your “Letter of Transmittal” (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

   Emerson Process Management, Liquid Division
   Liquid Division
   2400 Barranca Parkway
   Irvine, CA 92606

   Attn: Factory Repair

   RMA No. ____________

   Mark the package: Returned for Repair

   Model No. ____

12.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 11.2.

NOTE

Consult the factory for additional information regarding service or repair.

WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606

The shipping container should be marked:

Return for Repair
Model __________________________________

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.

The right people,
the right answers,
right now.

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CUSTOMER SUPPORT CENTER
1-800-854-8257

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