Manual
LIQ-MAN-TCL-1056, Rev E
July 2017

Rosemount™ TCL

Total Chlorine System with Rosemount 1056 Transmitter

ROSEMOUNT™

EMERSON™

Essential instructions

Read this page before proceeding!

Rosemount 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 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, call 1 800 999 9307, and Rosemount will provide the requested manual. 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 this 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 product 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 people, to prevent electrical shock and personal injury.

⚠ 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 installaiton system must comply with the governing approval agency (FM, CSA, or BASEEFA/CENELEC) hazardous area classification requirements. Consult your transmitter instruction manual for details.

Proper installation, operation, and servicing of this device in a hazardous area installation is entirely your responsibility.

⚠ 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 your responsibility.

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

Do not operate this instrument without the 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.

⚠ WARNING!

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

⚠ CAUTION!

SENSOR/PROCESS APPLICATION COMPATIBILITY

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

About this document

This manual contains instructions for installation and operation of the Rosemount TCL 1056 Total Chlorine Transmitter.

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

Rev level	Date	Notes
A	07/07	This is the initial release of the product manual. This manual has been reformatted to reflect the Emerson documentation style and updated to reflect any change in the product offering.
B	11/07	Page 3 additions to *Section 1.2*, page 5 changes to the Analyzer (option selection) table, page 14 updated the caution box, and page 15 updated *Section 4.3.3*.
C	07/10	Updated DNV logo.
D	05/11	Revised *Chapter 1*, replaced *Figure 3-3*, revised *Section 4.3.3*, replaced *Figure 4-4*, added to *Chapter 8*, and revised *Section 11.7.2*.
E	07/17	Changed instances of *analyzer* to *transmitter*. Updated formatting to align with new branding guidelines. Updated addresses on back page.

Contents

1 Description and specifications

1.1 Features

Rosemount 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 transmitter displays the total oxidant concentration in ppm as Cl_2.

Rosemount 1056 Transmitter

The Rosemount 1056 Transmitter measures total chlorine when used with the 499ACL-02 Sensor and TCL Sample Conditioning System.

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

Calibration and programming screens are simple and intuitive. Plain language prompts in six languages guide you through procedures. Information and diagnostic screens, as well as basic troubleshooting guidelines are available at the touch of a button.

The Rosemount 1056 Transmitter 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. An alarm activates when a transmitter or sensor fault occurs.

Rosemount 499ACL-02 Total Chlorine Sensor

The Rosemount 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 transmitter 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 transmitter 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

Table 1-1: Sample Conditioning System

Physical characteristics	Specifications
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	0 to 50 °C (32 to122 °F)
Ambient humidity	0 to 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	0 to 50 °C (32 to122 °F)
Total alkalinity	<300 mg/L as $CaCO_3$. For samples containing <50 mg/L alkalinity, consult the factory.

Table 1-1: Sample Conditioning System *(continued)*

Physical characteristics	Specifications
Sample conditioning system	
Reagent	Potassium iodide in vinegar
Reagent usage	5 gallons last approximately 60 days.
Reagent pump	Fixed speed peristaltic pump, about 0.2 mL/min
Sample pump	Fixed speed peristaltic pump, about 11 mL/min

Table 1-2: Rosemount 1056 Transmitter

Physical characteristics	Specifications
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. (15 mm). Display is programmable.
Languages	English, French, German, Italian, Spanish, and Portuguese
Ambient temperature and humidity	0 to 55 °C (32 to 131 °F); relative humidity 5 to 95% (non-condensing).
Storage temperature	-20 to 60 °C (-4 to 140 °F)
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 transmitter only. LR 34186 Class 1, 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 US, respectively.
RFI/EMI LVD	EN-61326 EN-6101-01 CE
Outputs	Two 4-20 mA or 0-20 mA isolated outputs. Continuously adjustable. Linear or logarithmic. Maximum load 550 ohms. Output dampening with a time constant of 5 sec is user-selectable.

Table 1-2: Rosemount 1056 Transmitter *(continued)*

Physical characteristics	Specifications
Alarms	Four alarm relays for process measurement(s) or temperature. Any 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 1 lb or 0.5 kg)	3 lb/4 lb (1.5 kg/2.0 kg)

Table 1-3: Rosemount 499ACL-02 Total Chlorine Sensor

Physical characteristics	Specifications
Wetted parts	Gold, Noryl®[1] (PPO), Viton®[2], EPDM, and silicone
Dimensions	1.0 x 5. 6 in. (25.4 x 143 mm)
Cable	25 ft (7.6 m) standard
Pressure rating	0 to 65 psig (101 to 549 kPa)
Temperature rating	0 to 50 °C (32 to 122 °F)
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.

Table 1-4: Performance Specifications - Complete System

Physical characteristics	Specifications
Linear range	0 to 20 ppm (mg/L) as Cl_2 (for higher ranges, consult factory)
Linearity (per ISO 15839)	0 to 10 ppm: 2%; 0 to 20 ppm: 3%
Response time	Following a step change in concentration, the reading reaches 90% of final value within 7 minutes at 25 °C (77 °F)
Drift	At about 1.5 ppm in clean water and constant temperature, drift is typically less than 0.05 ppm over two weeks.
Detection limit (per ISO 15839)	0.02 ppm (mg/L) in clean water at room temperature

1.3 Ordering information and accessories

Rosemount 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 a transmitter.

Important

Reagent kits must be ordered separately. Reagent kits for 0-5 ppm and 0-10 ppm chlorine are available. For higher ranges, consult the factory.

See *Table 1-5*.

Table 1-5: Rosemount TCL Total Chlorine System Ordering Information

Model	Sensor type
TCL	Total Chlorine System
Power input	
11	115 Vac 50/60 Hz
12	230 Vac 50/60 Hz
Transmitter	
-	No selection - no transmitter
270	Rosemount 1056-01-24-38-AN, no relays, analog output
271	Rosemount 1056-01-24-38-HT, no relays, HART®
272	Rosemount 1056-01-24-38 DP, no relays, Profibus DP
273	Rosemount 1056-03-24-38-AN, alarm relays, analog output
274	Rosemount 1056-03-24-38-HT, alarm relays, HART

Table 1-5: Rosemount TCL Total Chlorine System Ordering Information *(continued)*

275	Rosemount 1056-03-24-38-DP, alarm relays, Profibus DP
Sensor	
-	No selection - no sensor
30	Rosemount 499ACL-02-54 Total Chlorine Sensor with standard cable
31	Rosemount 499ACL-02-54-60 Total Chlorine Sensor with optimum EMI/RFI cable
32	Rosemount 499ACL-02-54-VP Total Chlorine Sensor with VP cable connector(1)
Typical model number: TCL-11-280-32	

(1) Interconnecting VP cable sold separately.

Accessories

Table 1-6: Sample Conditioning System Accessories

Part number	Description
24134-00	Air pump, 115 Vac, 50/60 Hz
24134-01	Air pump, 230 Vac, 50/60 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, 3 AG, slow blow for option-11 (115 Vac)
9100132	Fuse, 0.125 A, 250 V, 3 AG, 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
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
24164-00	Potassium iodide, 25 g, sufficient for 5 gallons (19 L) of vinegar (0-5 ppm total chlorine)
24164-01	Potassium iodide, 50 g, sufficient for 5 gallons (19 L) of vinegar (0-10 ppm total chlorine)
24165-00	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 25 g potassium iodide (0-5 ppm total chlorine)

Table 1-6: Sample Conditioning System Accessories *(continued)*

Part number	Description
24165-01	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 50 g potassium iodide (0-10 ppm total chlorine)

Table 1-7: Rosemount 1056 and 56 Transmitters Accessories

Part number	Description
23554-00	Cable glands (qty 5 of PG 13.5)
23820-00	Wall and 2 in. pipe mounting kti
240048-00	Stainless steel tag (specify marking)

Table 1-8: Sensor Accessories

Part number	Description
23501-02	Total chlorine membrane, includes 1 membrane assembly and 1 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)

Table 1-9: For First Time Variopol Installations

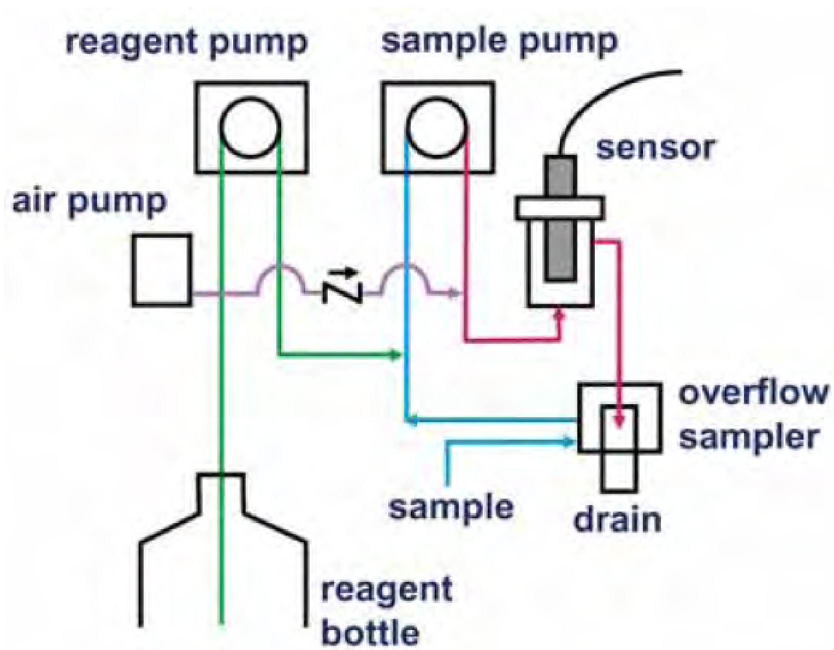
Part number	Description
23747-06	Interconnecting cable, VP 6, 2.5 ft (0.8 m)
23747-04	Interconnecting cable, VP 6, 4 ft (1.2 m)
23747-02	Interconnecting cable, VP 6, 10 ft (3.0 m)
23747-07	Interconnecting cable, VP 6, 15 ft (4.6 m)
23747-08	Interconnecting cable, VP 6, 20 ft (6.1 m)
23747-09	Interconnecting cable, VP 6, 25 ft (6.1 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)

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 system consists of a sample conditioning system, which injects the reagent into the sample, and a sensor and transmitter, 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 Transmitter



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 transmitter 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.

3 Installation

3.1 Unpacking and inspection

Complete the following steps when you unpack your instrument.

1. Inspect the shipping containers. If there is damage, contact the shipper immediately for instructions.
2. If there is no apparent damage, unpack the containers.
3. Ensure that all items shown on the packing list are present. If items are missing, notify Rosemount immediately.

3.2 Installation

3.2.1 General information

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

⚠ CAUTION!

HAZARDOUS AREAS

The TCL Total Chlorine Sample Conditioning System is not suitable for use in hazardous areas.

2. Install the transmitter and sample conditioning system in an area where vibrations and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the transmittter and sensor wiring at least one foot from high voltage conductors. Be sure there is easy access to the transmitter and sample conditioning system.
4. The transmitter 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 transmitter and sample conditioning cabinet does not exceed the length of the sensor cable.

3.2.2 Install the transmitter

1. Refer to the appropriate figure for installation details.

Type of mounting	Figure
Panel	*Figure 3-1*

Type of mounting	Figure
Wall or pipe	*Figure 3-2*

Figure 3-1: Panel Mounting Dimensions

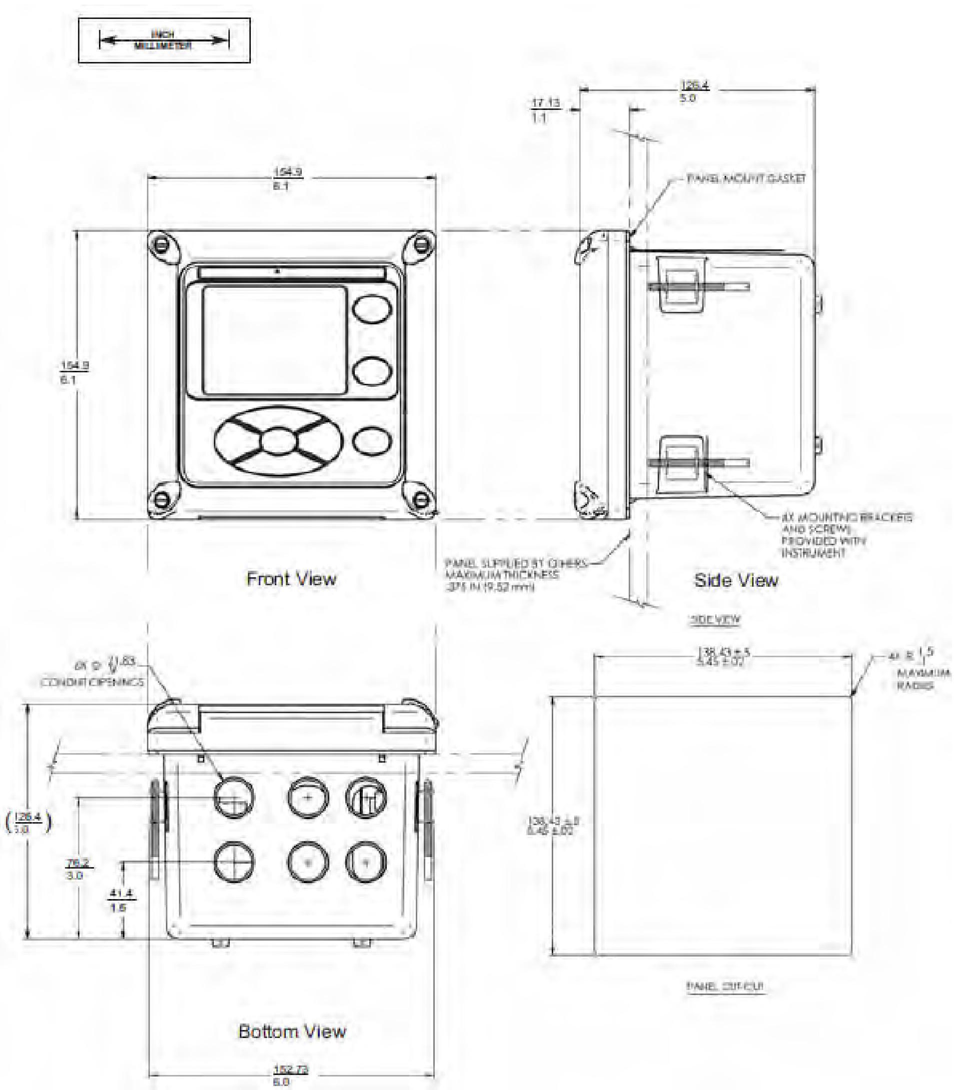
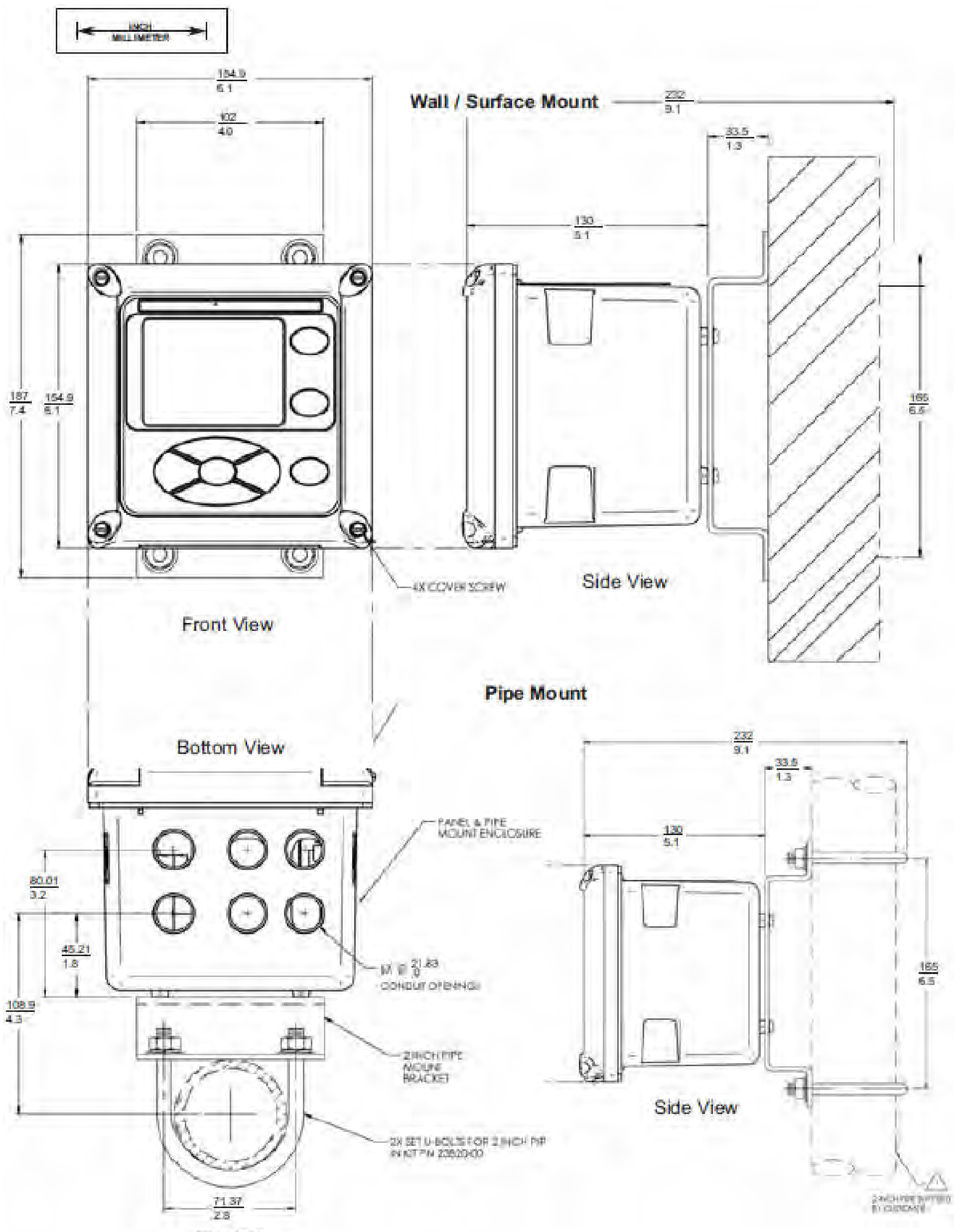


Figure 3-2: Pipe and Wall Mounting Dimensions



(Mounting bracket PN 23820-00)

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

3.2.3 Install the sample conditioning enclosure

Follow the steps below to install the sample conditioning enclosure.

Refer to *Figure 3-3*, *Figure 3-4*, and *Figure 3-5* for installation details.

Figure 3-3: Installing the Sample Conditioning Enclosure

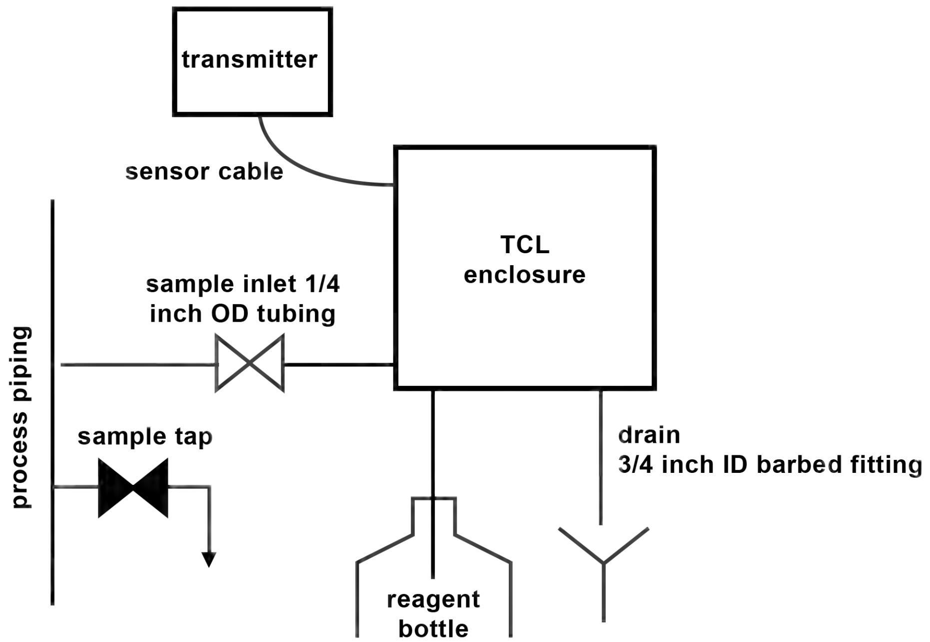


Figure 3-4: TCL Case Dimensions

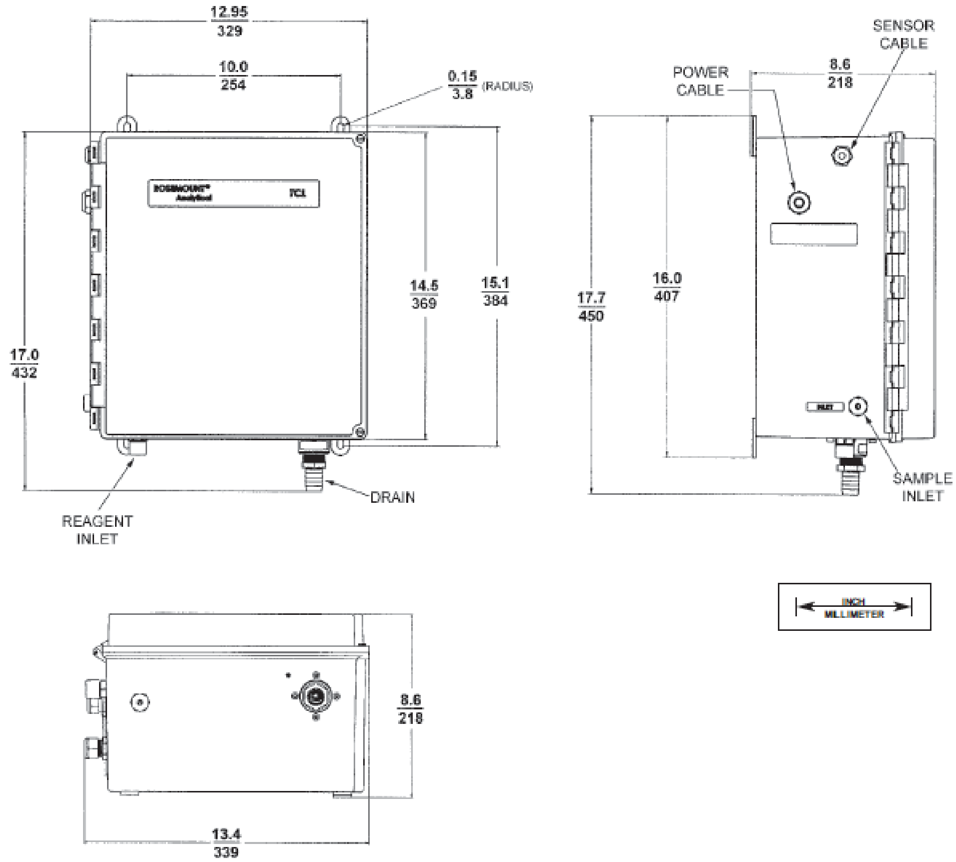
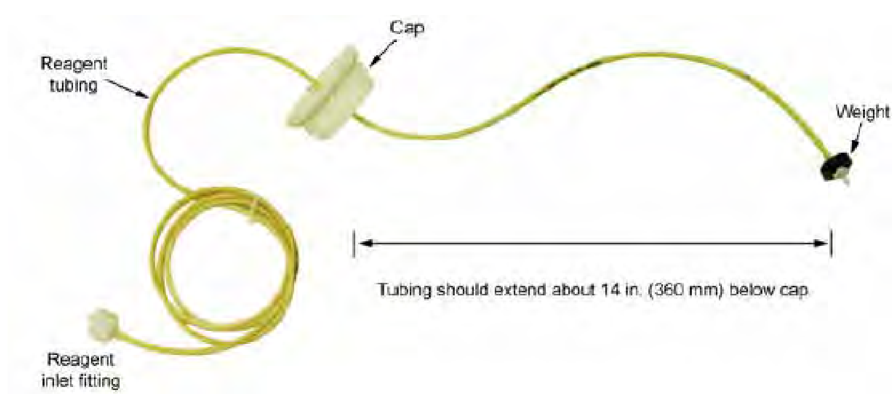


Figure 3-5: Reagent Tubing Assembly



Procedure

1. Connect the sample line to the sample conditioning system. Use 1/4 in. 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.
2. If a grab sample 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.
3. Connect the drain to a length of 3/4 in. ID flexible plastic tubing.

   Important

   The sample must drain to open atmosphere.

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4. 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*.
5. Place the blue plastic carboy beneath the enclosure. Screw the cap and tubing assembly on the carboy.

   To prepare reagent, see *Section 5.1*.

3.2.4 Install the sensor

Complete the following steps to install the Rosemount 499ACL-02 Sensor in the TCL system.

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 transmitter.

   Refer to *Section 4.4*.
3. Remove the nut and adapter from the flow cell.
4. Slip the nut over the end of the sensor.
5. Thread the adapter onto the sensor. Hand-tighten only.
6. If you are using a VP cable, connect the cable to the sensor.

   The connector and receptacle are keyed to ensure proper mating.

7. Once the key has slid into place, tighten the connection by turning the knurled ring clockwise.
8. Remove the protective cap from the end of the sensor.
9. Insert the sensor in the flow cell. Hand tighten the nut.

4 Wiring

4.1 Prepare transmitter conduit openings

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

Conduit openings accept 1/2 in. 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 transmitter (UL508-26 16).

4.2 Provide power to the sample conditioning system

Complete the following steps to power the sample conditioning system.

⚠ WARNING!

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

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 it as the disconnecting device for the sample conditioning system.

Procedure

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*.

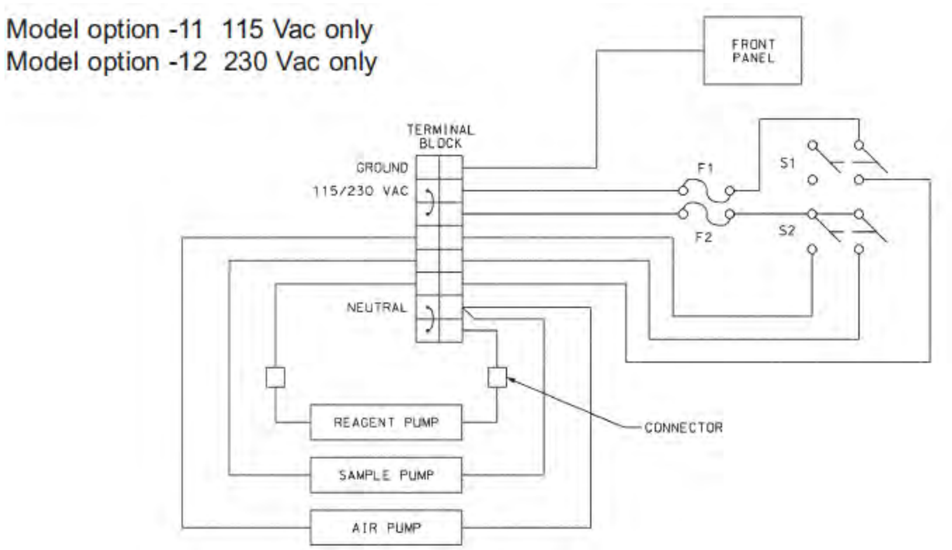
   See *Figure 3-4*.
4. Wire the power cable to the terminal strip as shown in *Figure 4-1*.

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not apply 230 Vac power to a 115 Vac TCL (Model option -11). Doing so will damage the instrument.

Figure 4-1: Power wiring



Important

Leave the pump power switches off until ready to start up the unit.

See *Chapter 5*.

4.3 Make power, alarm, output, and sensor connections in the transmitter

⚠ 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 codes.

4.3.1 Power

Wire AC mains power supply to the power supply board, which is mounted vertically on the left hand side of the transmitter enclosure.
The power connector is at the top of the board.

Procedure

1. Unplug the connector from the board and wire the power cable to it.

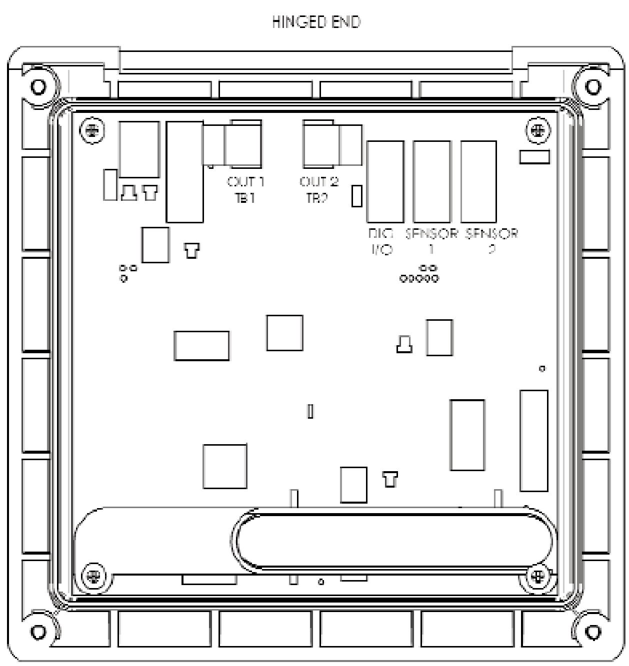
   Lead connections are marked on the connector. (*L* is live or hot; *N* is neutral; the ground connection has the standard symbol.)
2. AC power wiring should be 14 gauge or greater. Run the power wiring through the conduit opening nearest the power terminal.
3. Provide a switch or breaker to disconnect the transmitter from the main power supply.
4. Install the switch or breaker near the transmitter and label it as the disconnecting device for the transmitter.

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 4-2 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.

Figure 4-2: Analog output connections



The analog outputs are on the main board near the hinged end of the enclosure door.

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

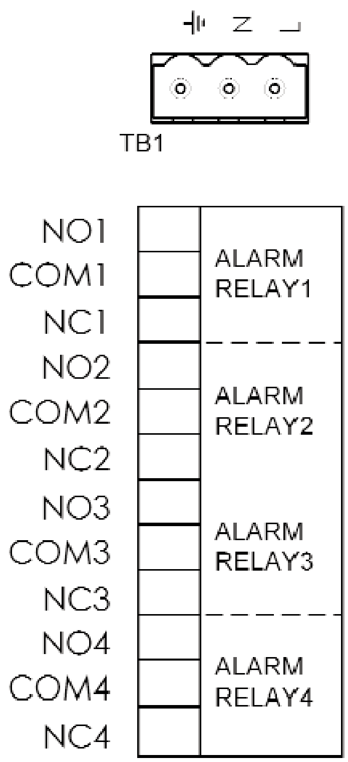
Keep output signal wiring separate from power wiring. Do not run signal and power or relay wiring in the same conduit or close together in a cable tray.

4.3.3 Alarm wiring

The alarm relay terminal strip is located just below the power connector on the power supply board.

See *Figure 4-3*.

Figure 4-3: Alarm relay connections



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.

4.4 Sensor wiring

If it is necessary to replace the sensor cable, refer to the instructions below.

1. Shut off power to the transmitter.

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 to the chlorine board. Refer to *Figure 4-4* or *Figure 4-5*.

Figure 4-4: Wiring Sensor with Optimum EMI/RFI or Variopol Cable to Rosemount 1056 Transmitter

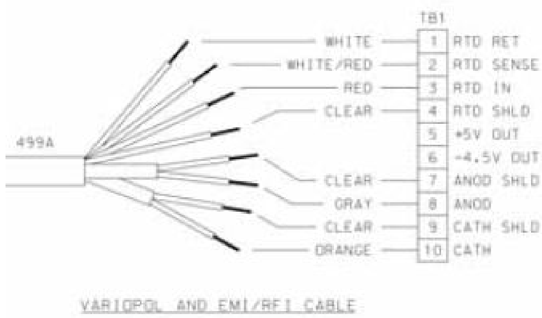
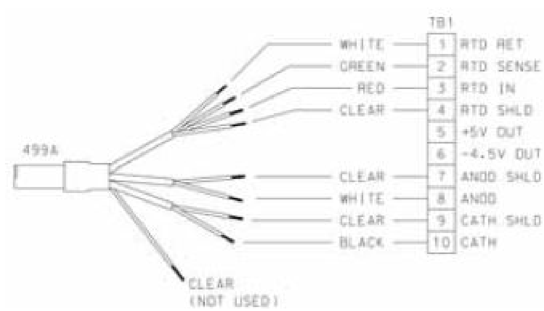


Figure 4-5: Wiring Power with Standard Cable to Rosemount 1056 Transmitter



6. Once the cable has been connected, slide the board fully into the enclosure while taking up the excess cable through the conduit opening.
7. If you are using a cable gland, tighten the gland nut to secure the cable and ensure a sealed enclosure.

4.5 Apply power to the transmitter and complete Quick Start

For Rosemount Total Chlorine System with Rosemount 1056 Transmitter

1. Once all wiring connections are secured and verified, apply power to the transmitter.

   When the transmitter 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 points up.

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

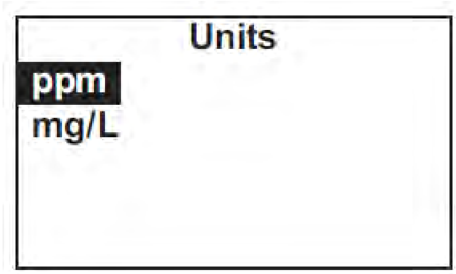
3. The next step is to configure sensor 1. Sensor 1 is the total chlorine sensor. The screen has two control boxes.

   a. For measurement, choose Total chlorine.

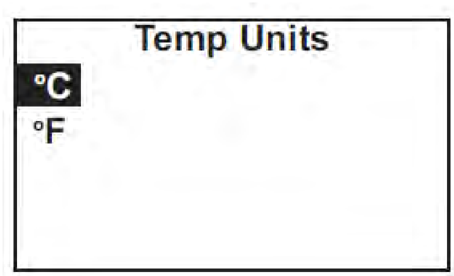
   b. Choose the desired units, mg/L or ppm.

4. Choose Total Chlorine for sensor 1 (S1).

5. Choose the desired units for chlorine.



6. Choose the desired temperature units.



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

7. 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 *Chapter 9*.

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**

5 Startup

Complete *Chapter 4* before starting this section.

5.1 Prepare the reagent

Complete the following steps to prepare the potassium iodide reagent.

⚠ WARNING!

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

Important
Do not prepare the solution until ready to use.

Procedure

1. Position the blue plastic carboy under the sample conditioning cabinet. Unscrew the cap and reagent tube assembly.
2. Add the potassium iodide reagent to the carboy.

   See the table.

Expected range, ppm as Cl_2	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

3. Add 5 gallons (19 L) of distilled white vinegar one gallon (4 L) at a time. Swirl the carboy after each addition.
4. Screw the cap on the carboy. Be sure the reagent uptake tube extends to the bottom of the carboy.
5. 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

Complete the following steps to zero the 499ACL-02 Total Chlorine 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 current is stable.
3. Zero the sensor.

   See *Section 9.3.2*.

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

Complete the following steps to start operating the Rosemount TCL and calibrate the 499ACL-02 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 fills rather slowly. Also observe that the air pump is operating.

   The pump produces very vigorous bubbling in the flow cell. 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.

2. Monitor the sensor current. Once the reading is stable, calibrate the unit.

   See *Section 9.3.3*. It may take thirty minutes or longer for the reading to stabilize when the sensor is first put in service.

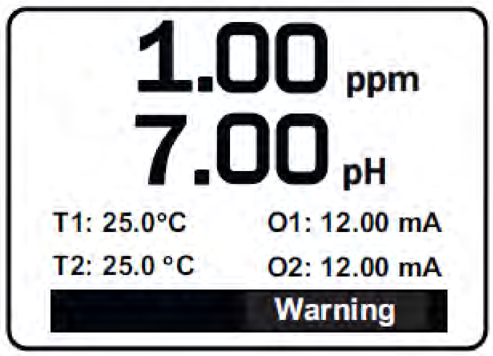
6 Display and operation

6.1 Display

The transmitter has a six line display.

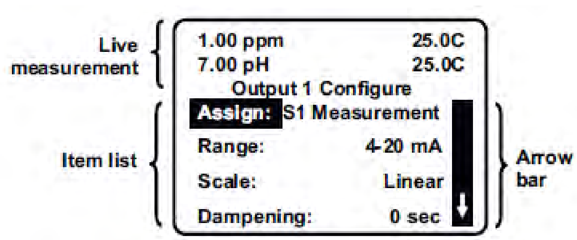
See Figure 6-1. The display can be customized to meet your requirements. Refer to Section 6.6.

Figure 6-1: Main Display



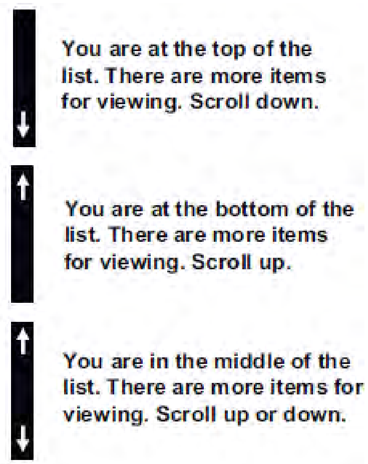
When the transmitter is being programmed or calibrated, the display changes to a screen similar to the one shown in Figure 6-2. The live readings appear in small font at the top of the screen. The rest of the display shows programming and calibration information. Programming items appear in lists. The screen can only show 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 6.2 and Section 6.3 for more information.

Figure 6-3: Arrow Bar



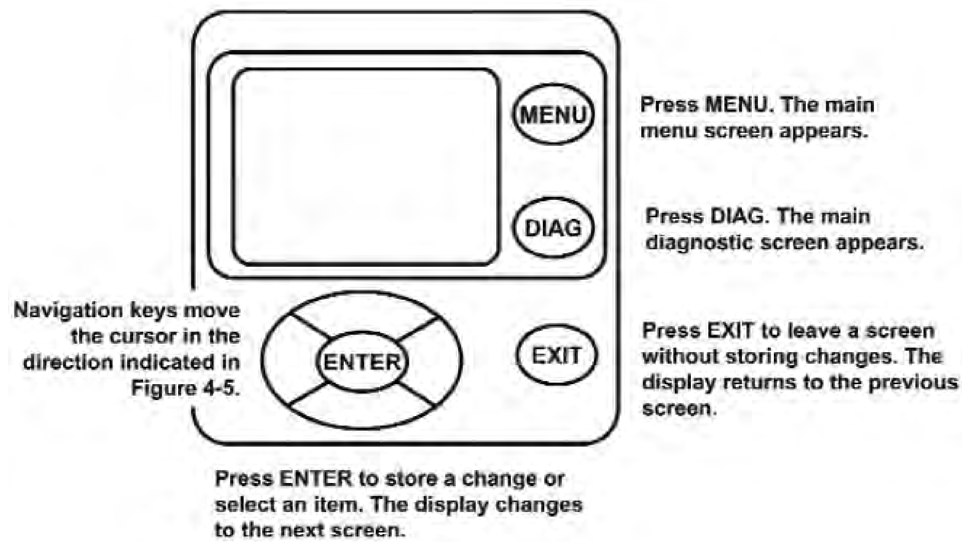
The arrow bar shows whether additional items in a list are available.

6.2 Keypad

Local communication with the transmitter is through the membrane keypad.

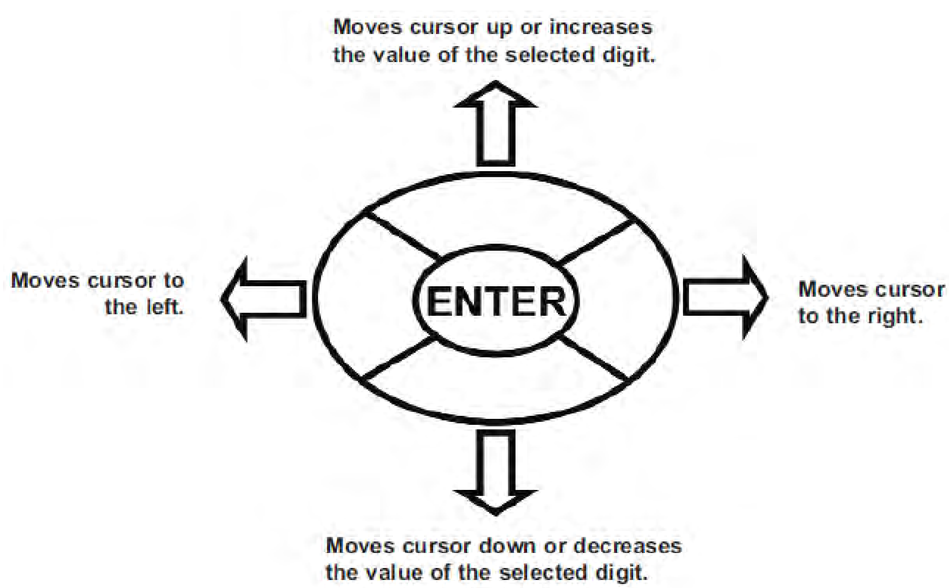
Figure 6-4 and *Figure 6-5* explain the operation of the keys.

Figure 6-4: Transmitter Keypad



Four navigation keys move the cursor around the screen. The position of the cursor is shown in reverse video. The navigation keys are used to increase or decrease the value of a numeral. Press ENTER *to select an item and store numbers and settings. Press* EXIT *to return to the previous screen without storing changes. Pressing* MENU *always causes the main menu to appear.*

Figure 6-5: Navigation Keys



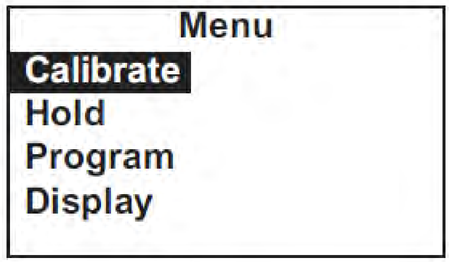
The operation of the navigation keys is shown. To move a decimal point, highlight it and then press Up *or* Down*.*

6.3 Programming the transmitter - tutorial

Setting up and calibrating the transmitter 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.

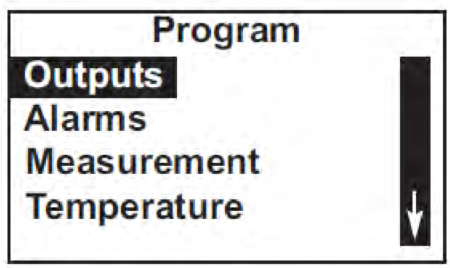
1. Press **MENU**.

   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.



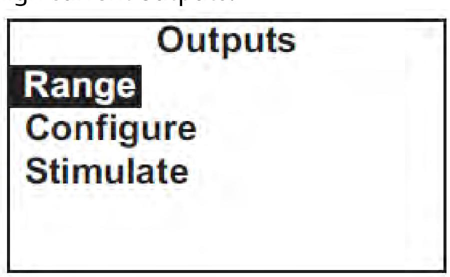
2. To assign values to the analog outputs, the **Program** sub-menu must be open. Use **Down** to move the cursor to Program. Press **ENTER**.

   The Program menu appears. There are between five and seven items in the Program menu. Alarms appears only if the transmitter contains the optional alarm relay board. The screen displays four items at a time. The downward pointing arrow on the right of the sreen shows there are more items available in the menu.



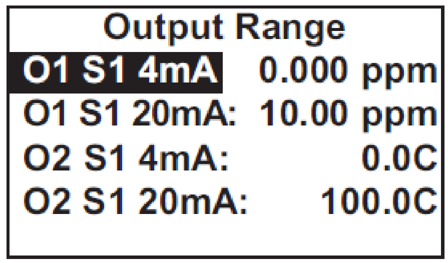
3. To view the other items, use **Down** to scroll to the last item shown and continue scrolling down. When you have reached the bottom, the arrow will point up. Move the cursor back to Outputs and press **ENTER**.

   The Outputs screen appears. The cursor is on Range. Output range is used to assign values to the low and high current outputs.



4. Press **ENTER**.

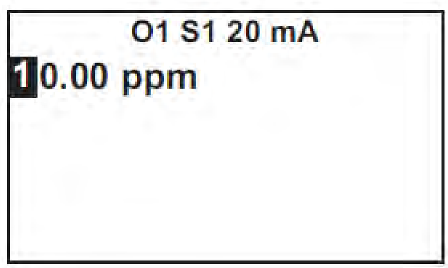
   The Output Range screen appears. The screen shows the present values assigned to output 1 (O1) and output 2 (O2). The screen also shows which sensors the outputs are assigned to. S1 is sensor 1, and S2 is sensor 2. S2 appears only if you have a dual input Rosemount 1056 transmitter. The assignments shown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



5. For practice, change the 20 mA settings for output 1 to 8.5 ppm.

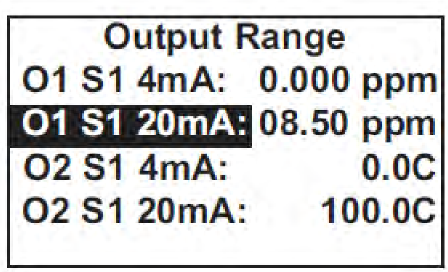
   a. Move the cursor to the O1 S1 20 mA: 10.00 line and press **ENTER**.

      The screen below appears.



   b. Use the navigation keys to change `10.00` to `8.5` ppm. Use **Left** and **Right** to move from digit to digit. Use **Up** and **Down** to increase or decrease the numeral.
   c. To move the decimal point, press **Left** or **Right** until the decimal point is highlighted. Press **Up** to move the decimal point to the right. Press **Down** to move to the left.
   d. Press **ENTER** to store the setting.

   The display returns to the summary screen. Note that the 20 mA setting for output 1 has changed to `8.50 ppm`.



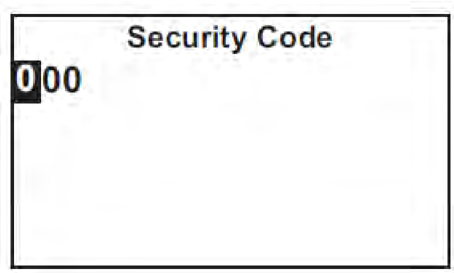
6. To return to the main menu, press **MENU**. To return to the main display, press **MENU** and then **EXIT**.

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.

1. A user can view the default display and diagnostic screens only.
2. A user has access to the calibration and hold menus only.
3. A user has access to all menus.



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 loss than restored, hold is automatically turned off.

6.5.2 Using the hold function

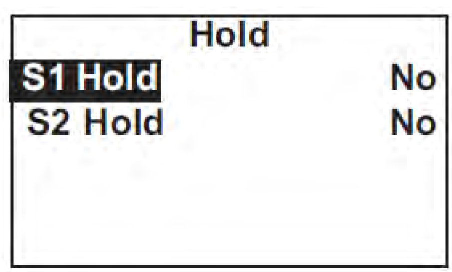
To put the sensor in hold, complete the following steps.

1. Press MENU.

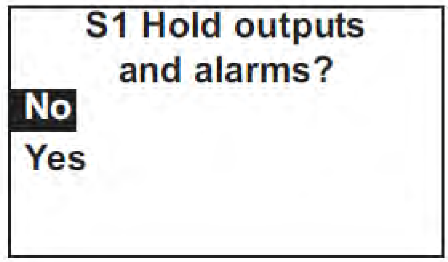
   The main Menu screen appears.

2. Choose Hold.

   The screen shows the current hold status for each sensor.



3. Select the sensor to be put in hold. Press **ENTER**.



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

6.6 Configuring the main display

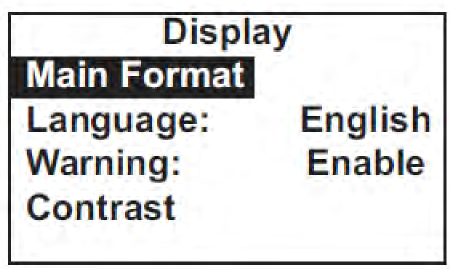
The main display can be configured to meet your requirements.

1. Press **MENU**.

   The main menu screen appears.

2. Move the cursor to Display and press **ENTER**.

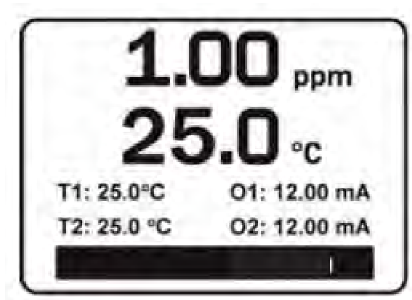
   The screen shows the present configuration. There are four items: Main Format, Language, Warning, and Contrast.



3. 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.

4. Press **ENTER** to store the setting.
5. 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**.



6. Scroll through the list of items and select the parameter you wish to be displayed.
7. Once you are done making changes, press **EXIT** twice to return to the display menu.
8. Press **MENU** and 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 Rosemount 1056 Transmitter, other abbreviations might appear. Consult the Rosemount 1056 Transmitter manual for more details.
9. Choose Language to change the language used in the display.
10. Choose Warning to disable or enable warning messages.
11. Choose Contrast to change the display contrast.
12. To change the contrast, choose either lighter or darker and press **ENTER**.

    Every time you press **ENTER**, the display becomes lighter or darker.

7 Programming the transmitter

7.1 General

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

1. Configure and assign values to the analog current outputs.
2. Configure and assign values to the alarm relays (if the alarm board is installed).
3. Choose the type of chlorine measurement being made. This step is necessary because the transmitter used with the TCL can measure forms of chlorine other than total chlorine.
4. Choose temperature units or manual temperature correction.
5. Set two levels of security codes.
6. Reset the transmitter to factory default settings.

7.2 Default settings

The transmitter leaves the factory with the default settings for total chlorine shown in *Table 7-1*. You can change the settings to any value shown in the column labeled Choices. If you have a dual input Rosemount 1056 Transmitter, refer to the Rosemount 1056 Transmitter Instruction Manual for information about the default settings for the second input.

Table 7-1: Default Settings

Item	Choices	Default
Outputs		
1. Assignments		
a. output 1	chlorine, temp	chlorine
b. output 2	chlorine, temperature	temperature
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 22.0 mA	22.0 mA
6. Dampening	0 to 999 sec	0 sec

Table 7-1: Default Settings *(continued)*

Item	Choices	Default
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, temperature, fault, interval timer	chlorine
b. AL3 and AL4	chlorine, temperature, 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)		
a. units	ppm or mg/L	ppm
b. resolution	0.01 or 0.001	0.001
c. input filter	0 to 999 sec	5 sec
Temperature related settings		
1. Units	°C or °F	°C
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. 4mA	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.

Important
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 transmitter detects a fault.
2. Ranging the output means assigning values to the low (0 or 4 mA) and high (20 mA) outputs.
3. Simulating an output means making the transmitter generate an output equal to the value you enter.

7.3.2 Definitions

Analog current output	The transmitter provides either a continuous 4-20 mA or 0-20 mA output signal proportional to chlorine or temperature.
Assigning an output	Outputs can be assigned to either the measurement (total chlorine) or temperature. If a dual input transmitter is being used, the outputs are freely assignable to either sensor.
Linear output	Linear output means the current is directly proportional to the value of the variable assigned to the output (chlorine or temperature).
Logarithmic output	Logarithmic output means the current is directly proportional to the common logarithm of the variable assigned to the output (chlorine or temperature).
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.
Fault	The transmitter continuously monitors itself and the sensor(s) for faults. If the transmitter 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 to the previously programmed value (between 0.00 and 22.00 mA) when a fault occurs. Live means the selected output is unaffected when the fault occurs.

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

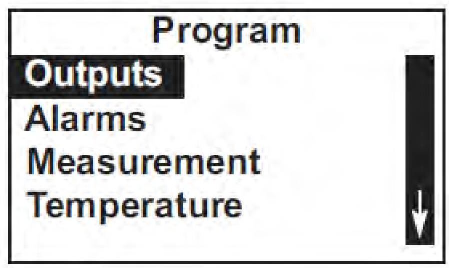
Complete the following steps to configure the analog current outputs.

1. Press MENU.

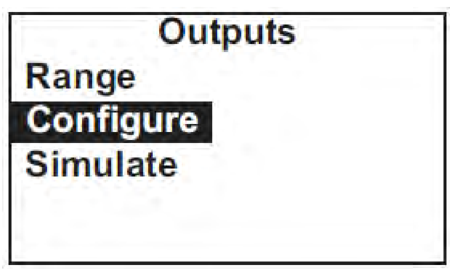
   The main Menu screen appears.

2. Move the cursor to Program and press ENTER.

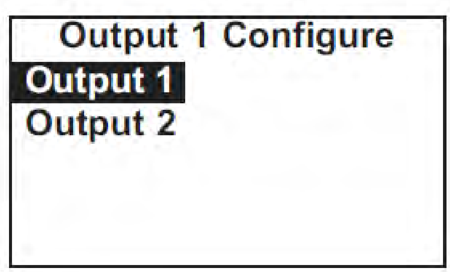
   The cursor is on Outputs.



3. Press ENTER.

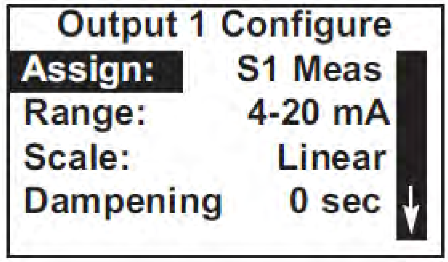


4. Choose Configure.



5. Choose Output 1 or Output 2.

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.



6. 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.

7. Press **ENTER** to store the setting.

   For an explanation of terms, see *Section 7.3.1* and *Section 7.3.2*.

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

7.3.4 Procedure - ranging outputs

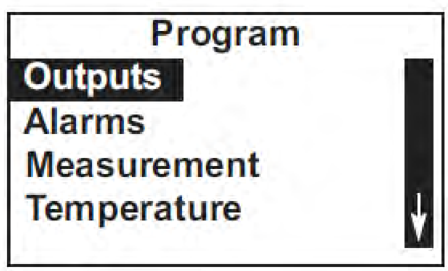
Complete the following steps to range the outputs by assigning values to the low and high outputs.

1. Press **MENU**.

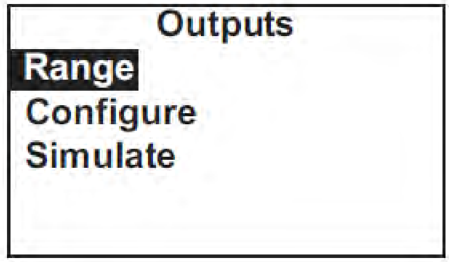
   The main Menu screen appears.

2. Move the cursor to Program and press **ENTER**.

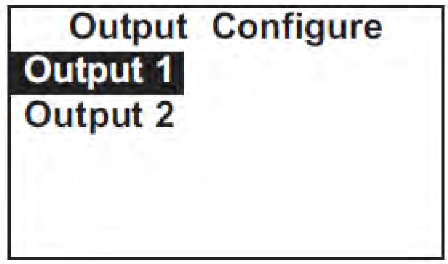
   The cursor is on Outputs.



3. Press **ENTER**.

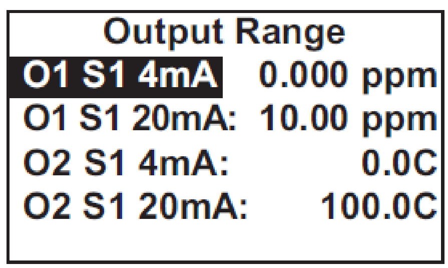


4. Choose Range.



5. Choose Output 1 or Output 2.

   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.



6. 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.

7. Press ENTER to store the setting.

   For an explanation of terms, see *Section 7.3.1* and *Section 7.3.2*.

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

7.3.5 Procedure - simulating outputs

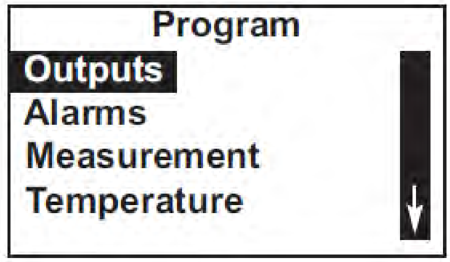
Complete the following steps to simulate an output by making the transmitter generate an output current equal to the value you enter.

1. Press MENU.

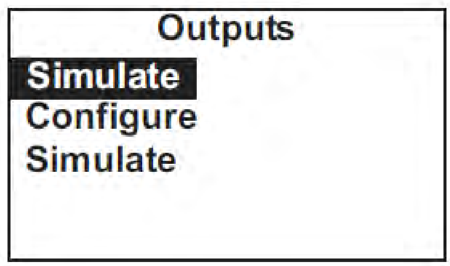
The main Menu screen appears.

2. Move the cursor to Program and press **ENTER**.

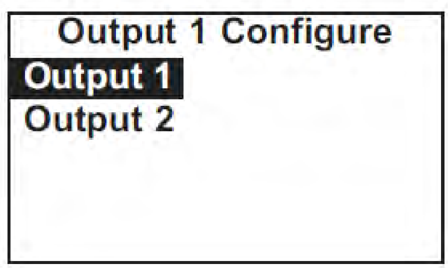
   The cursor is on Outputs.



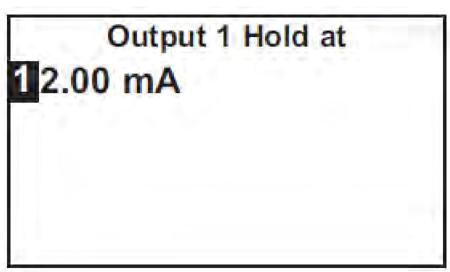
3. Press **ENTER**.



4. Choose Simulate.



5. Choose Output 1 or Output 2.



6. Enter the desired simulated output current.

7. To end the simulated current, press **MENU** or **EXIT**.

7.4 Configuring alarms and assigning setpoints

7.4.1 Purpose

The Rosemount 1056 Transmitter 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.

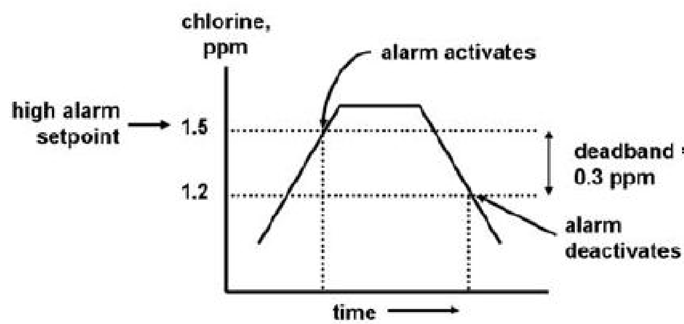
Important
Configure the alarms first.

1. Configuring an alarm means
   a. Assigning a sensor and measurement (chlorine or temperature) to an alarm. If a dual input transmitter 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 the deadband.
   d. Setting the interval timer parameters.
2. Simulating an alarm means making the transmitter energize or de-energize an alarm relay.

7.4.2 Definitions

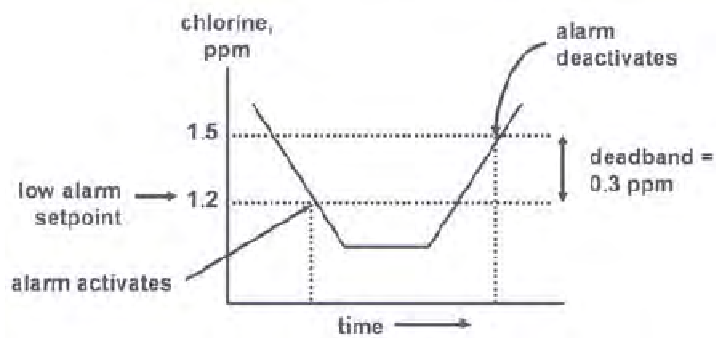
Assigning alarms	There are four alarm relays. The relays are freely assignable to either the measurement (chlorine) or temperature. Alarm relays can also be assigned to operate as interval timers or as fault alarms. A fault alarm activates when the transmitter detects a fault in either itself of the sensor.
Fault alarm	A fault condition exists when the transmitter detects a problem with the sensor or with the transmitter itself that is likely to cause seriously erroneous readings. If an alarm was programmed as a fault alarm, the alarm activates. At the same time, a fault message appears in the main display.
Alarm logic, setpoints, and deadbands	See *Figure 7-1* and *Figure 7-2*.

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

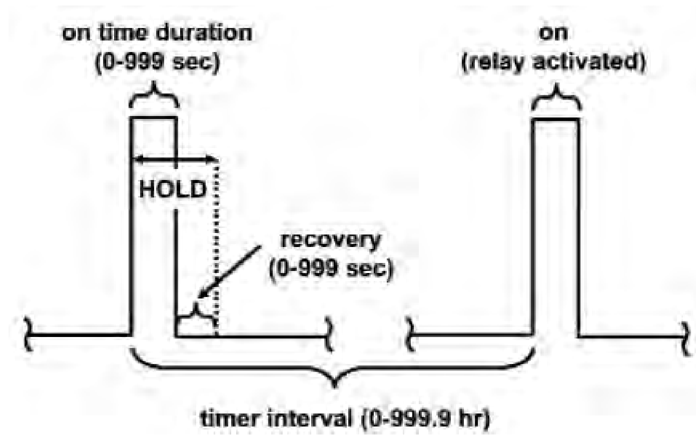


The alarm activates when the chlorine concentration drops below the low setpoint. The alarm remains activated until the reading increases above the value determined by the deadband.

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 outputs, and assigned alarms for the sensor can be put on hold. During hold, the main display remains at the last value.

Figure 7-3: Operation of the Interval Timer



The numbers in parentheses are the allowed values for each timer parameter.

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.

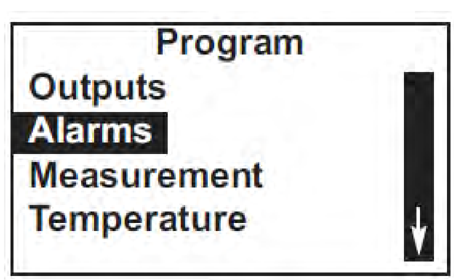
7.4.3 Procedure - configuring alarms and assigning setpoints

Complete the following steps to configure the alarms and assign setpoints.

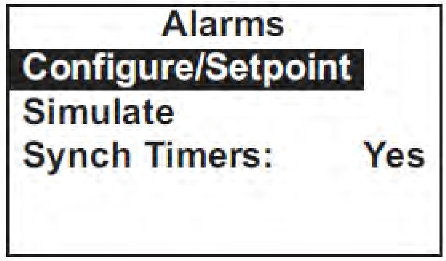
1. Press MENU.

   The main Menu screen appears.

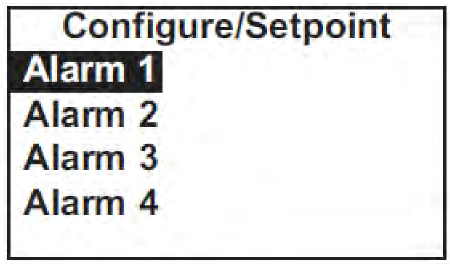
2. Move the cursor to Program and press ENTER.



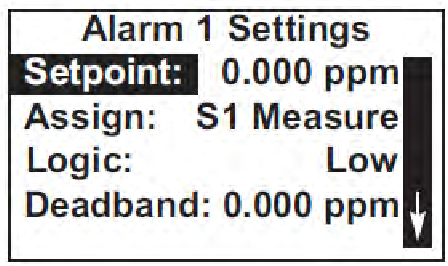
3. Choose Alarms.



4. Choose Configure/Setpoint.



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



The screens 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.

6. 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.

7. Press ENTER to store the setting.

   For an explanation of terms, see *Section 7.4.1* and *Section 7.4.2*.

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

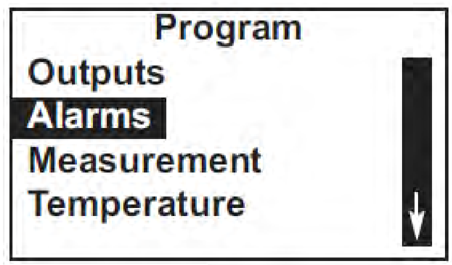
7.4.4 Procedure - simulating alarms

Complete the following steps to make the transmitter energize or de-energize an alarm relay.

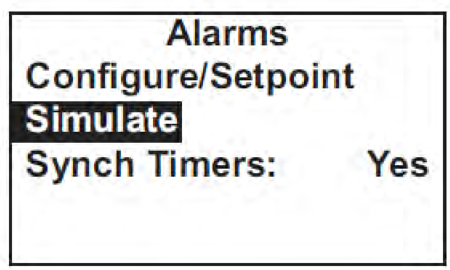
1. Press **MENU**.

   The main Menu screen appears.

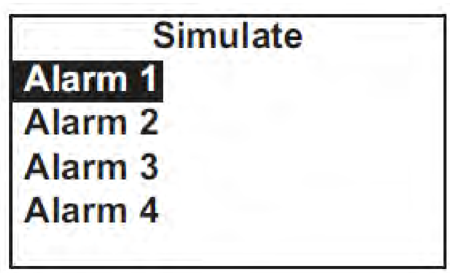
2. Move the cursor to Program and press **ENTER**.



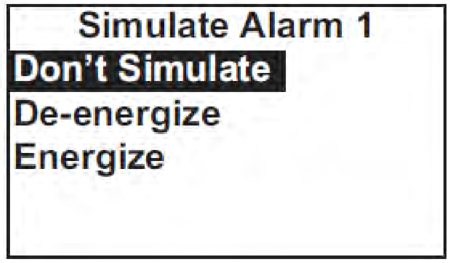
3. Choose Alarms.



4. Choose Simulate.



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



6. Choose Don't simulate, De-energize, or Energize.
7. Press **MENU** or **EXIT** to end simulation.

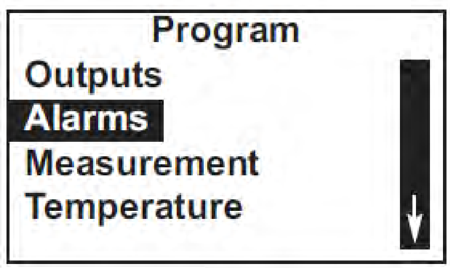
7.4.5 Procedure - synchronizing timers

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

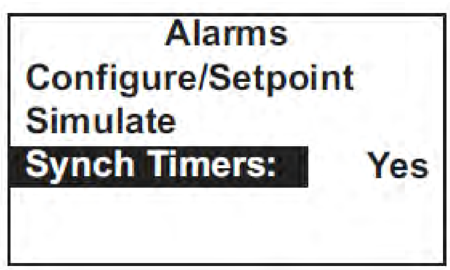
1. Press **MENU**.

   The main Menu screen appears.

2. Move the cursor to Program and press **ENTER**.



3. Choose Alarms.



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

4. To make a change, choose Synch Timers and press **ENTER**.

   A screen appears in which the present setting can be edited.

5. Press **ENTER** to store the setting.

For an explanation of terms, see *Section 7.4.1* and *Section 7.4.2*.

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

7.5 Configuring the measurement

7.5.1 Purpose

This section describes the following:

1. Program the transmitter to measure total chlorine. This step is necessary, because the transmitter 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

Chlorine oxidants	Although the TCL is used to measure total chlorine only, the Rosemount 1056 Transmitter used with the TCL can be used to measure other chlorine oxidants, for example, monochloramine and free chlorine.
Filter	The transmitter applies a software 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 transmitter applies a window filter. The 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 transmitter 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 timer 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.
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`.

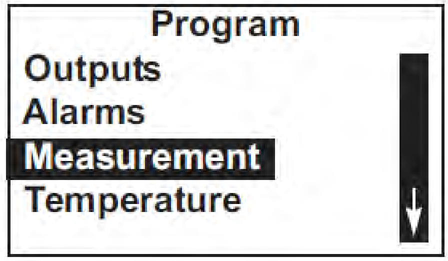
7.5.3 Procedure - configuring the measurement

Complete the following steps to configure the transmitter to measure total chlorine.

1. Press MENU.

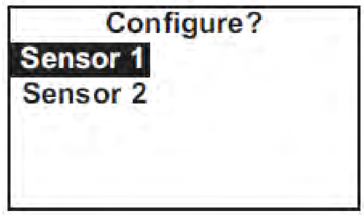
   The main Menu screen appears.

2. Move the cursor to Program and press ENTER.



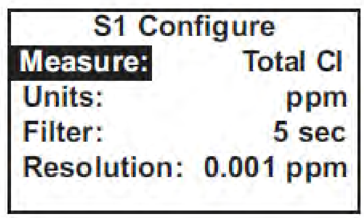
3. Choose Measurement.

   The screen below appears only if you have a dual input 1056.



   Choose the chlorine sensor.

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



4. 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.

5. 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 *Section 7.5.2*

6. To return to the main display, press MENU and 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

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 transmitter reading to increase even though the chlorine level remained constant. In automatic temperature correction, the transmitter uses the temperature measured by the sensor for the correction.

Manual temperature correction In manual temperature correction, the transmitter uses the temperature you enter 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 2 °C. Manual temperature correction is useful if the sensor temperature element has failed and a replacement sensor is not available.

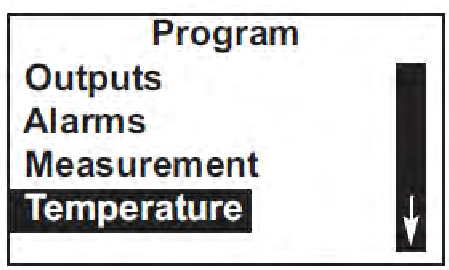
7.6.3 Procedure - configuring temperature related settings

Complete the following steps to set the temperature units and to select automatic or manual temperature correction.

1. Press MENU.

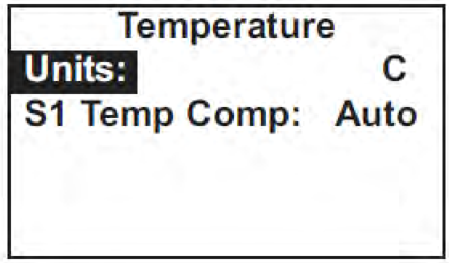
   The main Menu screen appears.

2. Move the cursor to Program and press ENTER.



3. Choose Temperature.

   The screen summarizes the present sensor configuration. There are between two and five items. Units and S1 Temp Comp always appear. If manual temperature compensation was selected, the manual temperature value also appears. If you have a dual input transmitter, temperature compensation items 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.



4. 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.

5. To store a setting, press **ENTER**.

   For an explanation of terms, see *Section 7.6.1* and *Section 7.6.2*.

6. To return to the main display, press **MENU** and 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.

1. A user can view the default display and diagnostic screens only.
2. A user has access to the calibration and hold menus only.
3. 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.

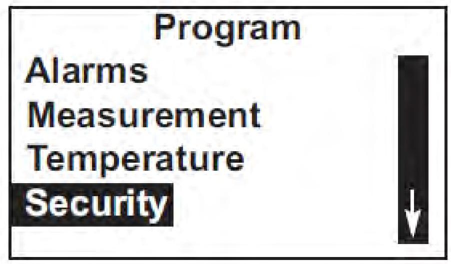
7.7.2 Procedure - configuring security settings

Follow the steps below to set security codes.

1. Press **MENU**.

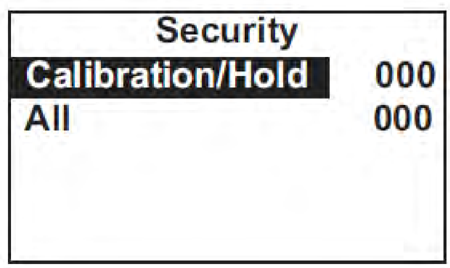
   The main Menu screen appears.

2. Move the cursor to Program and press **ENTER**.



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

   The screen shows the existing security codes.



4. 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.

5. Press **ENTER** to store a change.

   The security code takes effect two minutes after pressing **ENTER**.

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

7.8 Resetting the transmitter

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 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 value 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.

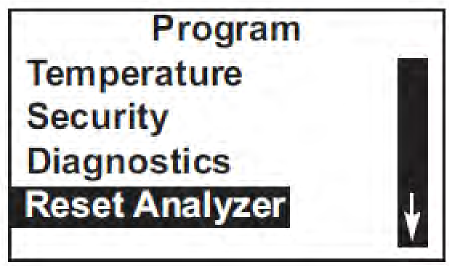
7.8.2 Procedure - resetting the transmitter

Complete the following steps to reset the transmitter.

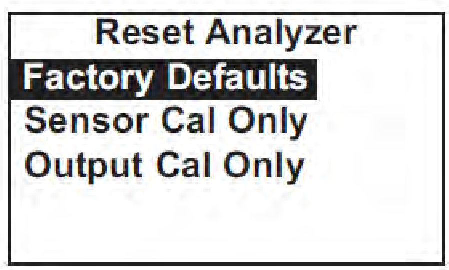
1. Press MENU.

   The main Menu screen appears.

2. Move to Program and press ENTER.



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



4. 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.

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

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

9 Calibration

9.1 Introduction

The **Calibrate** menu allows you 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 agent, 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 changes if either the concentration or the temperature changes. To account for changes in sensor current caused by temperature alone, the transmitter automatically applies a membrane permeability correction. The membrane permeability changes about 3%/° C at 25 °C (77 °F), 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/transmitter 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 transmitter reading match the temperature measured with a standard thermometer.

9.2.2 Procedure

Complete the following steps to calibrate the temperature in the transmitter.

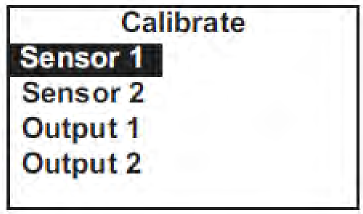
1. Remove the sensor from the flow cell. Place it in an insulated container of water along with a calibrated thermometer. Submerge at least the bottom two inches of the sensor.
2. Allow the sensor to reach thermal equilibrium.

   The time constant for the sensor is about five minutes, so it may take as long as thirty minutes for equilibration.

3. Press **MENU**.

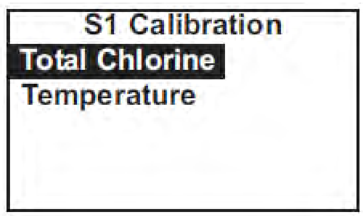
   The main Menu screen appears. The cursor is on Calibrate.

4. Press **ENTER**.

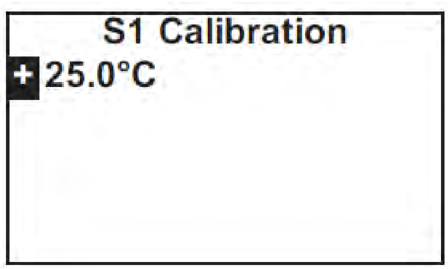


5. Choose the sensor you wish to calibrate.

   Sensor 2 appears only if you are using a dual input transmitter.



6. Choose Temperature.



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

   If the present temperature is more than 5 °C different from the value entered, an error message appears.

8. To force the transmitter to accept the calibration, choose Yes. To repeat the calibration, choose No.

   For troubleshooting assistance, see *Section 11.5*.

9. To return to the main display, press **MENU** and 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 Rosemount 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 transmitter can be calibrated to read total chlorine.

Figure 9-1: Determination of Total Chlorine

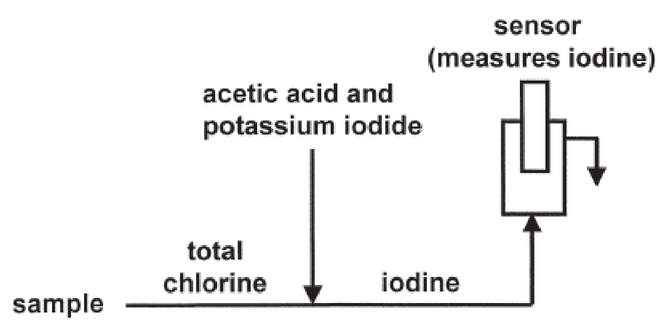
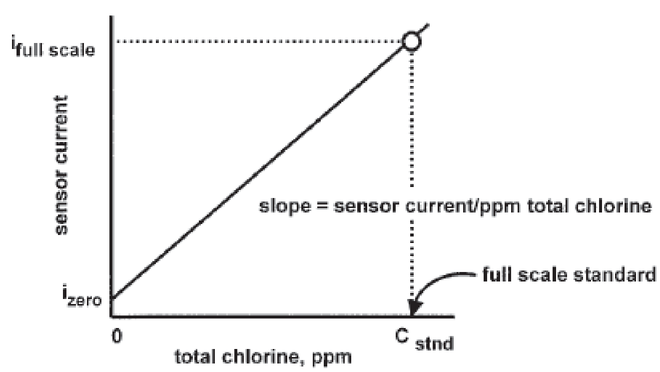


Figure 9-2 shows a typical calibration curve for a total chlorine sensor. Because the sensor really measures iodine, calibrating the sensor requires exposing it to a solution containing no iodine (zero standard) and to a solution containing a known amount of iodine (full-scale standard).

Figure 9-2: Sensor Current as a Function of Total Chlorine Concentration



The zero standard is necessary, because the sensor, even when no iodine is present, generates a small current called the residual current or zero current. The transmitter 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 makes a good zero standard.

Important

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.

Important

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 standards when taking and testing the grab sample.

- Take the grab sample from a point as close 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.

9.3.2 Procedure - zeroing the sensor

Complete the following steps to calibrate the sensor with the zero standard.

1. Remove the sensor from the flow cell and place it in a beaker of deionized water. Be sure no air bubbles are trapped against the membrane. Observe the sensor current.

   The current drops rapidly at first and then gradually reaches a stable zero value.

2. To monitor the sensor current, press DIAG.
3. 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.

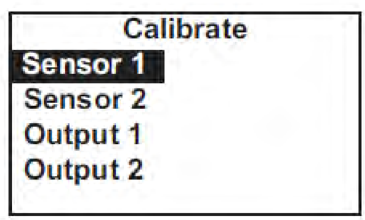
Important

Do not start the zero routine until the sensor has been in the zero solution for at least two hours.

4. Press MENU.

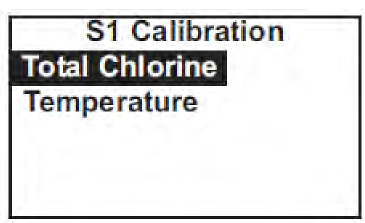
   The main Menu screen appears. The cursor is on Calibrate.

5. Press ENTER.

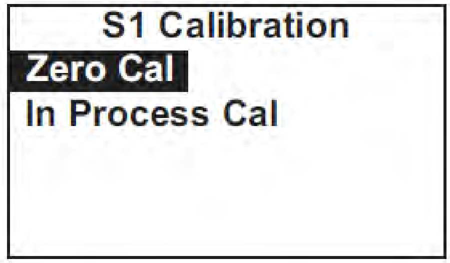


6. Choose the sensor you wish to calibrate.

   Sensor 2 only appears if you have a dual input Rosemount 1056 Transmitter.



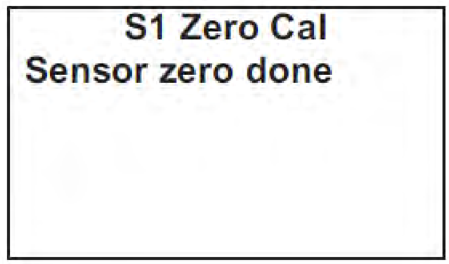
7. Choose Total Chlorine.



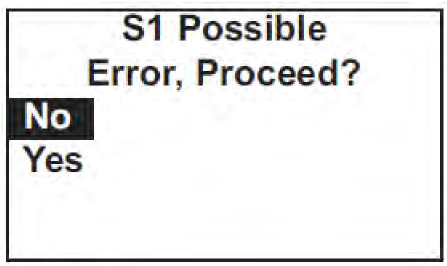
8. Choose Zero Cal.

   The transmitter automatically starts the zero calibration.

   If the zero calibration was successful, the following screen appears.



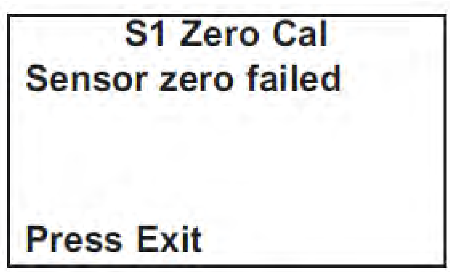
   If the zero current is moderately larger than expected, an error message appears.



9. To force the transmitter to accept the zero current, choose Yes. To repeat the calibration, choose No.

   For troubleshooting information, see *Section 11.5*.

   If the zero current is much larger than expected, the zero calibration failure screen appears.



The transmitter will not update the zero current. For troubleshooting assistance, see *Section 11.5*.

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

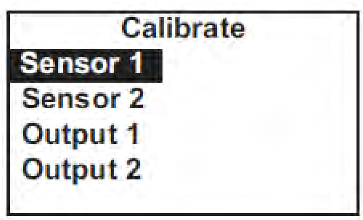
9.3.3 Procedure - calibrating the sensor

Complete the following steps to calibrate the total chlorine sensor with the full scale standard solution.

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 operating range. Wait until the transmitter reading is stable before starting calibration.

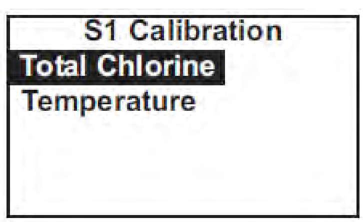
   When the TCL is first started up or when a new sensor is put in service, allow at least 30 minutes for the reading to stabilize.
3. Press MENU.

   The main Menu screen appears. The cursor is on Calibrate.
4. Press ENTER.

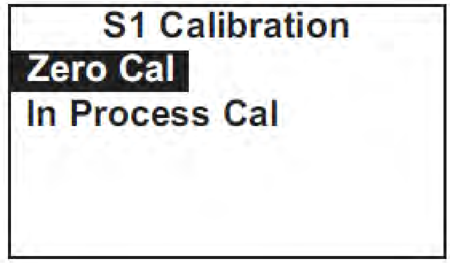


5. Choose the sensor you wish to calibrate.

   Sensor 2 appears only if you have a dual input Rosemount 1056 Transmitter.



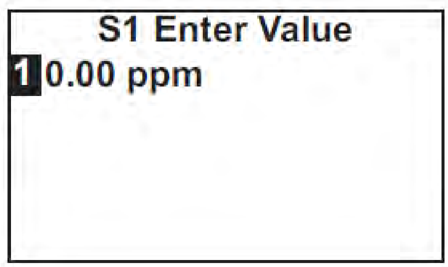
6. Choose Total Chlorine.



7. Choose In Process Cal.
8. Follow the screen points. Once the reading is stable, press ENTER. Take the sample and press ENTER.

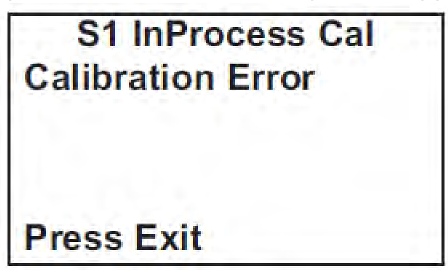
   At this point, the transmitter stores the present sensor current and temperature and uses those values in calibration.

9. Determine the total chlorine concentration in the sample and enter the value in the screen below.

   See *Section 9.3.1* for sampling and testing precautions.

   If the calibration was successful, the live reading changes to the value entered in step 9, and the display returns to the screen in step 6. If the sensitivity is too far outside the range of expected values the following screen appears.

   The transmitter doesn't update the calibration. For troubleshooting assistance, see *Section 11.5*.

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

9.4 Calibrating analog outputs

9.4.1 Purpose

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

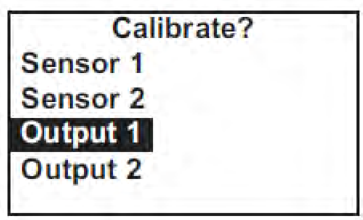
9.4.2 Procedure

Complete the following steps to calibrate the transmitter's analog outputs.

1. Connect a calibrated milliameter across the output you wish to calibrate. If a load is already connected to the output, disconnect the load.

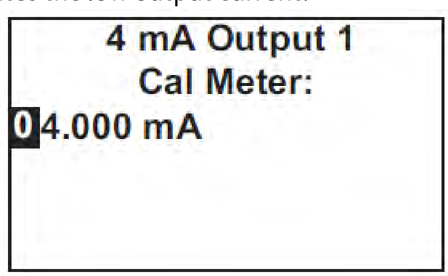
   Do not put the milliameter in parallel with the load.
2. Press MENU.

   The main Menu screen appears. The cursor is on Calibrate.
3. Press ENTER.



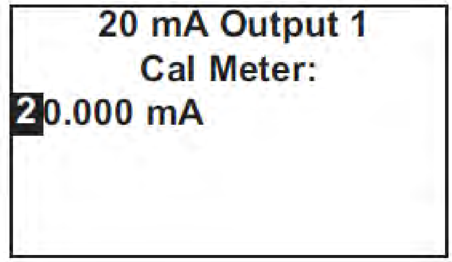
4. Choose the output you wish to calibrate.

   The transmitter simulates the low output current.



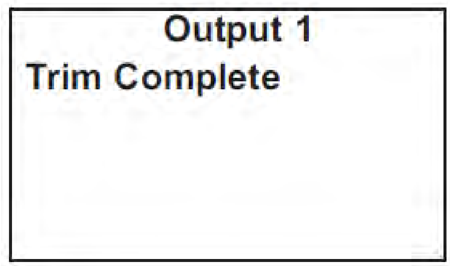
5. Change the value in the display to match the reading from the milliameter.

   The transmitter simulates the 20 mA output current.



6. Change the value in the display to match the reading from the milliameter.

   If the calibration was successful, the screen below appears.



   If the user entered value is more than ±1 mA different from the nominal value, a possible error screen appears.

7. To force the transmitter to accept the calibration, choose Yes.
8. To return to the main display, press MENU and then EXIT.

10 Maintenance

10.1 Transmitter

The Rosemount 1056 Transmitter used with the TCL requires little maintenance. Clean the transmitter 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 transmitter, consult the Rosemount 1056 Instruction Manual for the part number of the other board.

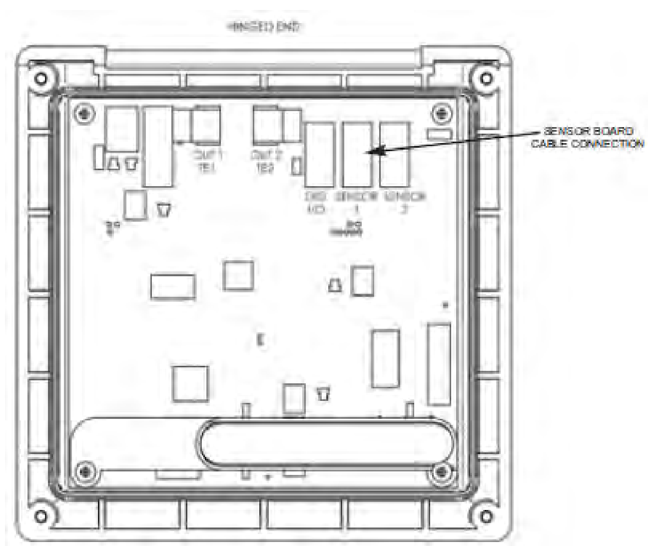
To replace the board:

Procedure

1. Turn off power to the transmitter.
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*.

Figure 10-1: Sensor Board Connections



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.

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 following calibration. Maintenance frequency is best determined by experience. For a sensor used in potable water, expect to clean the membrane every month and replace the membrane and electrolyte solution every three months.

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

Complete the following steps to replace the membrane on the total chlorine sensor.

1. Hold the sensor with the membrane facing up.
2. Unscrew the 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 carbon 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 electrolyte solution and membrane

⚠ WARNING!

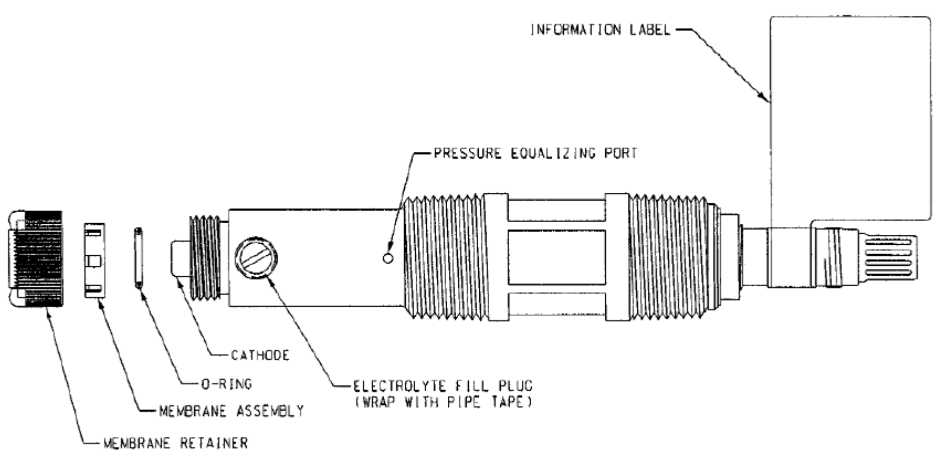
HARMFUL SUBSTANCE
Fill solution may cause irritation. Avoid contact with skin and eyes. May be harmful if swallowed..

Procedure

1. Unscrew the membrane retainer.
2. Remove the membrane assembly and O-ring.

   See *Figure 10-2*.

Figure 10-2: Sensor Parts



3. Hold the sensor over a container with the cathode pointing down.
4. Remove the fill plug.
5. Allow the electrolyte solution to drain out.
6. Remove the old pipe tape from the plug.
7. Wrap the plug with two turns of pipe tape and set aside..
8. Prepare a new membrane.
   a. Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up.
   b. Fill the cup with electrolyte solution.
   c. Set it aside.
9. Hold the sensor at about a 45° angle with the cathode end pointing up.
10. Add electrolyte solution (PN 9210438) through the fill hole until the liquid overflows.

11. Tap the sensor near the threads to release trapped air bubbles.
12. Add more electrolyte solution if necessary.
13. Place the fill plug in the electrolyte port and begin screwing it in.
14. After several threads have engaged, rotate the sensor so that the cathode is pointing up and continue tightening the fill plug.

    Do not overtighten.
15. Place a new O-ring in the groove around the cathode post.
16. Cover the holes at the base of the cathode stem with several drops of electrolyte solution.
17. Insert a small blunt probe, like a toothpick with the end cut off, through the pressure equalizing port.

    See *Figure 10-2*.

    ⚠ CAUTION!

    EQUIPMENT DAMAGE

    Do not use a sharp probe. It will puncture the bladder and destroy the sensor.
18. Place a drop of electrolyte solution on the cathode; then place the membrane assembly over the cathode.
19. Screw the membrane retainer in place.

Table 10-1: Spare Parts

Part number	Description
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 three membrane assemblies and three 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 two 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.

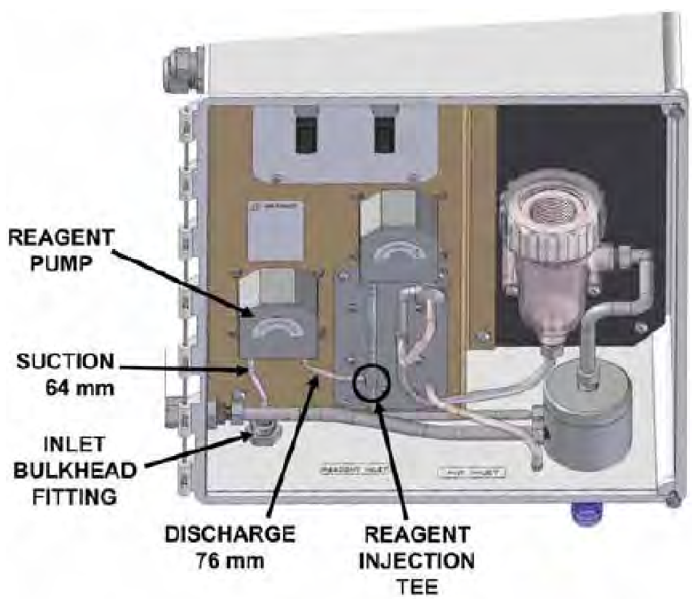
10.3.2 Sample and reagent tubing

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*.

Reagent tubing is shown in *Figure 10-3*.

Figure 10-3: Replacing Reagent Tubing



To replace reagent tubing:

Procedure

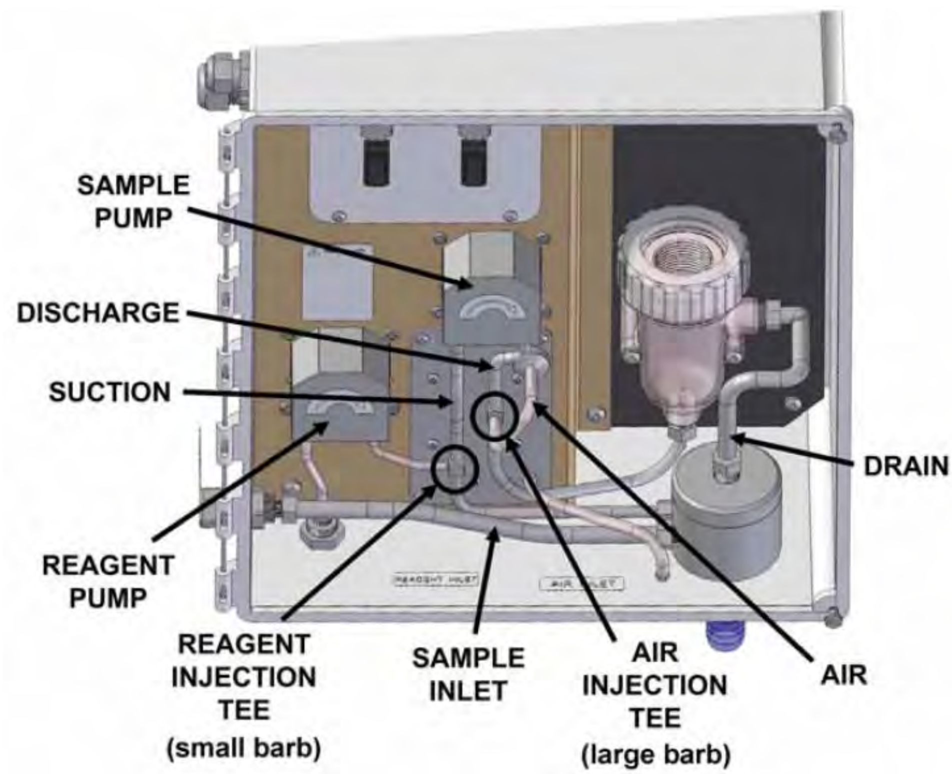
1. Turn off sample and reagent pumps.
2. Luer fittings connect the reagent tubing to the pump. Disconnect the tubing by turning the fitting in the direction of the arrows shown in *Figure 10-5*.
3. Disconnect the other end of the suction tubing from the barb on the reagent inlet fitting in the bottom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

Note that the discharge tubing is longer than the suction tubing.

10.3.3 Replacing sample tubing

To replace sample tubing:
Sample tubingis shown in *Figure*.

Figure 10-4: Replacing sample tubing



Procedure

1. Turn off the sample and reagent pumps.
2. 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*.
3. Disconnect the other end of the sample pump suction tubing from the overflow sampler. Pull the reagent injection tubing off the reagent injection tee.
4. Disconnect the other end of the sample pump discharge tubing from the flow cell. Pull the air injection tubing off the air injection tee.
5. Disconnect the sample inlet and drain tubing.
6. 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.

7. Install replacement sample inlet and drain tubing.

   The sample inlet tubing is longer than the drain tubing.

10.3.4 Peristaltic pump tubing

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

Procedure

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

   See *Figure 10-5*.

Figure 10-5: Luer Fittings

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: Pump Cover

4. Using your thumb as shown in *Figure 10-7*, push the tubing fitting straight outward until the fitting slides out of the socket.

Figure 10-7: Pushing the Tubing Fitting Out

5. Remove and discard the pump tubing.
6. Insert the new tubing one end at a time. Tongues on the sides of the gray fittings at the end of the tube fit into receiving grooves in the pump casing. Push the fitting in 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.

   See *Figure 10-8*.

Figure 10-8: Inserting New Tubing

7. Replace the pump cover.

a. Place the cover on the pump casing.

See *Figure 10-9*.

Figure 10-9: Replacing the Pump Cover

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: Pins

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: Track

d. Push down until the cover snaps into place.

8. Reconnect the tubing.

10.3.5 Replacing the air pump

Complete the following steps to replace the air pump on your total chlorine system.

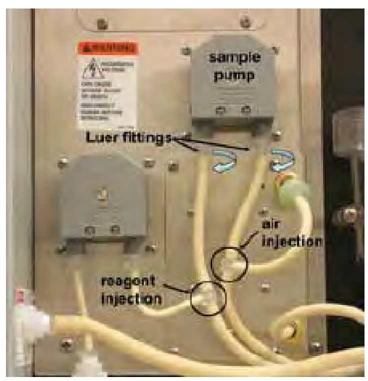
⚠ WARNING!

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

Procedure

1. Disconnect power to the transmitter.
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 tubing in the bottom of the enclosure.

Figure 10-12: Replacing the Air Pump



3. Remove the four screws (circled in *Figure 10-12* and *Figure 10-13*) holding the air pump access panel. Pull out the pump and panel.

Figure 10-13: Air Pump Access Panel

4. Disconnect the air inlet and outlet tubing from the air pump.

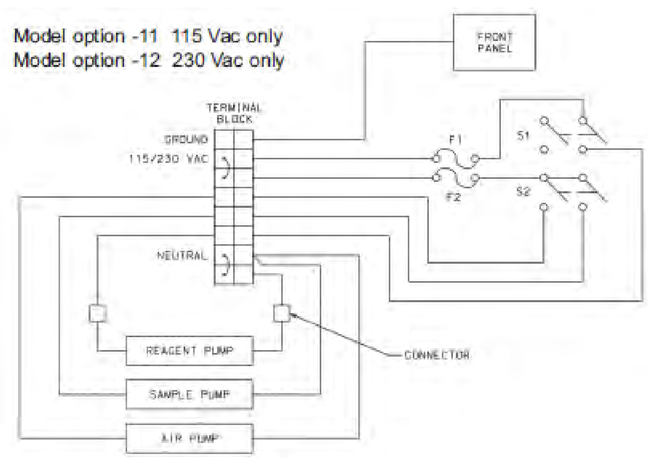
   See *Figure 10-14*.

Figure 10-14: Air Inlet and Outlet Tubing

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. Discard the old air pump.

   See *Figure 10-15*.

Figure 10-15: Terminal Strip



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.

10.3.6 Replacing the air pump diaphragm and check valves

Complete the following steps to replace the air pump diaphragm and check valves on your total chlorine system.

⚠ WARNING!

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

Procedure

1. Disconnect power to the transmitter.

2. Refer to *Figure 10-12*. Disconnect the reagent and air injection tubes. Disconnect the suction and discharge fitting by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed fitting at 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.

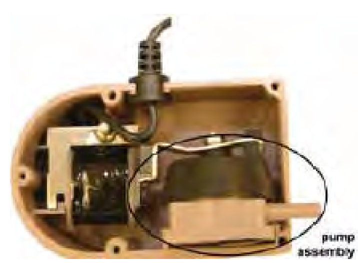
   See *Figure 10-16*.

Figure 10-16: Inlet Fitting

8. Slide the pump assembly out of the air pump body.

   See *Figure 10-17*.

Figure 10-17: Pump Assembly



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 injection tubing. Connect the air inlet tubing to the barbed fitting at the bottom of the enclosure.

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, 3 AG, slow blow for option -11 (115 Vac)
9100132	Fuse, 0.125 A, 250 V, 3 AG, 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 10.3.2*)
24135-00	Reagent uptake tubing, 65 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 10.3.2*)
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)

11 Troubleshooting

11.1 Overview

The transmitter continuously monitors itself and the sensor(s) for problems. When the transmitter identifies a problem, the word `warning` or `fault` appears intermittently in the lower line of the display. When the `fault` or `warning` message appears, press DIAG for more information.

See *Section 11.2*.

Warning The instrument or sensor is usable, but you should take steps as soon as possible to correct the condition causing the warning.

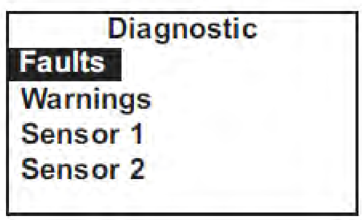
Fault The measurement is seriously in error and is not to be trusted. A fault condition might also mean that the transmitter has failed. Correct fault conditions immediately. When a fault occurs, the analog output goes to 22.00 mA or to the value programmed in *Section 7.3.3*.

11.2 Using the diagnostic feature

Complete the following steps to troubleshoot your transmitter with the diagnostic feature.

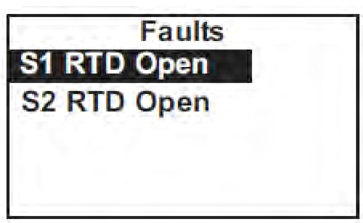
1. To read diagnostic messages, press DIAG.

   The screen below appears.



2. To display fault messages, select Faults. To display warning messages, select Warnings. To read measurement information about the sensor(s), including raw sensor signal and calibration data, choose the desired sensor and press ENTER.

   If you choose Faults or Warnings, a screen like the one below appears. S1 means sensor 1. S2 means sensor 2.



3. For additional troubleshooting information, select the desired message and press **ENTER**.

   For more information, see *Section 11.3*.

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

11.3 Troubleshooting when a Fault message is showing

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

1. Cycle the power off and then on.
2. If cycling the power does not help, call the factory.

The main board must be replaced. To do this, you must return the transmitter to the factory.

3. If cycling the power does not help and the fault message was `Main Board User Data`, reset the transmitter to factory default, re-enter user settings, and repeat calibration.

   See *Section 7.8*.

11.3.2 Hardware Error

Hardware error means that 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.
2. Inspect the connecting cable for obvious tears or breaks.
3. If the ribbon cable is properly seated and appears undamaged, replace the sensor board.

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 main and sensor board revision numbers. To read the main board revision, press **DIAG** and scroll down until `Inst SW Ver` is showing. To view the software board revision, press **DIAG**, 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 and 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. If the sensor is being installed for the first time, check the wiring connections.

   See *Section 4.3*.

2. Disconnect the sensor from the transmitter and measure the resistance between the RTD and return wires.

   See *Figure 4-4* or *Figure 4-5*.

3. If there is an open circuit, replace the sensor.
4. If there is no open circuit, check the transmitter.

   See *Section 11.5*.

11.3.7 Sensor 1 Not Detected

The ribbon cable from sensor 1 (chlorine) board must be plugged into the sensor 1 plug. See *Figure 4-3* for the location of the sensor board connectors.

Procedure

1. Confirm that the ribbon cable connecting sensor 1 (chlorine) board to the main board is plugged into the 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 errors

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 and 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

The 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 transmitter displays the out of range error message.

1. Check wiring connections.
2. Disconnect the sensor from the transmitter and use an ohmeter to check the resistance across the RTD.

See *Figure 4-4* or *Figure 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 transmitter.

   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.	*Section 11.4.1*
Sensor Negative Reading	The chlorine reading is less than -0.5 ppm.	*Section 11.4.2*
Sensor RTD Sense Open	RTD sensor line is broken or not connected.	*Section 11.4.3*
Sensor Temperature High	Temperature is greater than 155 °C (311 °F).	*Section 11.4.4*
Sensor Temperature Low	Temperature is less than -20 °C (-4 °F).	*Section 11.4.4*

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 transmitter 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.

2. If it is greater than 50 nA, repeat the zero step.

   If the zero current is in the correct range, the negative reading might be the result of the raw current or the senstivity being too low. A properly operating sensor should generate 1000 nA for every 1 ppm of total chlorine.

3. Recalibrate the sensor. If necessary, clean or replace the membrane and check the fill solution.
4. Replace the sensor.

11.4.3 Sensor RTD Sense Open

The transmitter measures temperature using a three-wire RTD.

See *Figure 11-4*. 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 transmitter to correct for the resistance of the in and return leads and to compensate for changes in lead resistance caused by changes in ambient temperature.

Procedure

1. Check wiring. See *Figure 4-4* or *Figure 4-5*.
2. Disconnect the sense and return wires and measure the resistance between them.

   It should be less than 1 Ω. See *Figure 4-4* or *Figure 4-5*. Even though the sense line is open, the sensor is still usable.
3. 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 transmitter be able to compensate for changes in ambient temperature. The error could be several °C 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 *Figure 4-5*. The resistance should be close to the values given in *Section 11.7.2*.
3. Replace the 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 15 nA.	*Section 11.5.1*
Error or warning message appears while zeroing the sensor (zero current is too high).	*Section 11.5.1*
Zero current is unstable.	*Section 11.5.2*
Sensor can be calibrated, but the current is too low.	*Section 11.5.3*
Process readings are erratic or wander.	*Section 11.5.4*
Readings drift.	*Section 11.5.5*
Readings are too high.	*Section 11.5.6*

Problem	See Section
Readings are too low.	*Readings are too low.Section 11.5.3*
Current output is too low.	*Section 11.5.8*
Alarm relays do not operate when setpoint is exceeded or do not release when reading is below setpoint.	*Section 11.5.9*

11.5.1 Zero current is too high.

1. Is the sensor properly wired to the transmitter? See *Section 4.4*.
2. Is the zero solution chlorine free? Take a sample of the solution and test it for total chlorine. The concentration should be less than about 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 residual 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 transmitter? See *Figure 4-4* and *Figure 4-5*. Verify that all wiring connections are tight.
2. Readings are often erratic when a new sensor is first placed in service. Readings usually stabilize after about an hour.
3. Is the space between the membrane and cathode mesh 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.
4. Verify that the sensor is filled with electrolyte solution. Refer to .

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 actic 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.

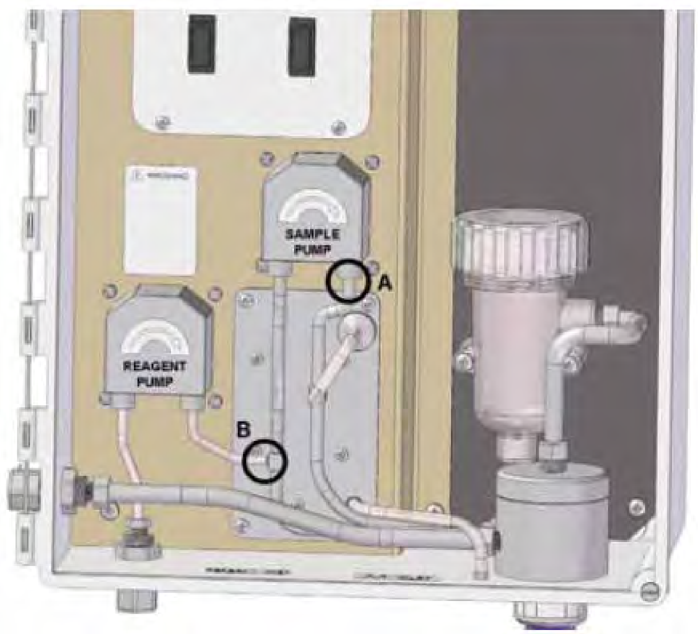
Expected range, ppm as Cl_2	Amount of KI needed per 5 gallons of vinegar	Part number
0-5 ppm	25 grams	24164-00
0-10 ppm	50 grams	24164-01
0-20 ppm	2 x 50 grams	24164-01

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 10.3.4* 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 transmitter? See *Section 4.4*. 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 in 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 information.

11.5.5 Readings drift.

1. Is the sample temperature changing? Membrane permeability is a function of temperature. The time constant for the Rosemount 499ACL-02 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 with a stream of water from a wash bottle. Wipe the membrane with a soft tissue.
3. Is the sensor new or has it been recently 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 was more than 3 °C different from transmitter

1. Is the standard thermometer, RTD, or thermistor accurate? General purpose liquid-in glass thermometers, particularly ones that have been mistreated, can have suprisingly 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 is too low.

Load resistance is too high. Maximum load is 600 Ω.

11.5.9 Alarm relays don't work.

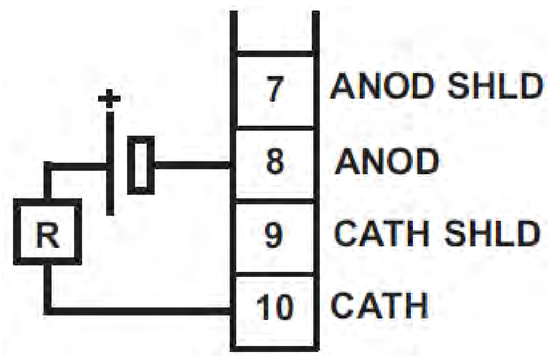
1. Verify the relays are properly wired.
2. Verify that deadband is correctly set. See *Section 7.4*.

11.6 Simulating inputs

To check the performance of the transmitter, use a decade box and 1.5 V 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 1.5 V battery as shown in *Figure 11-2*.

Figure 11-2: Simulating Chlorine



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 **INFO**. Choose sensor 1. The input current is the second line in the display.
4. Change the decade box resistance and verify that the correct current is shown. Calculate current from the equation:

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

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

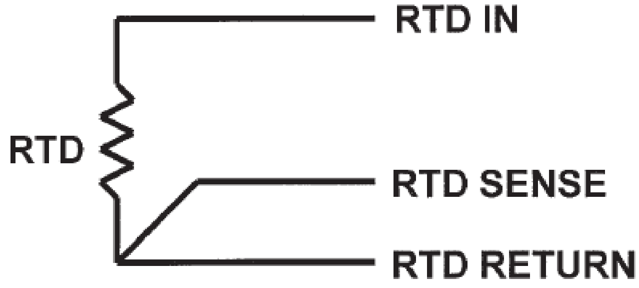
11.7 Simulating temperature

11.7.1 General

The Rosemount 1056 Transmitter accepts a Pt100 RTD. The Pt100 RTD is a three-wire configuration.

See *Figure 11-3*.

Figure 11-3: Three-Wire RTD Configuration

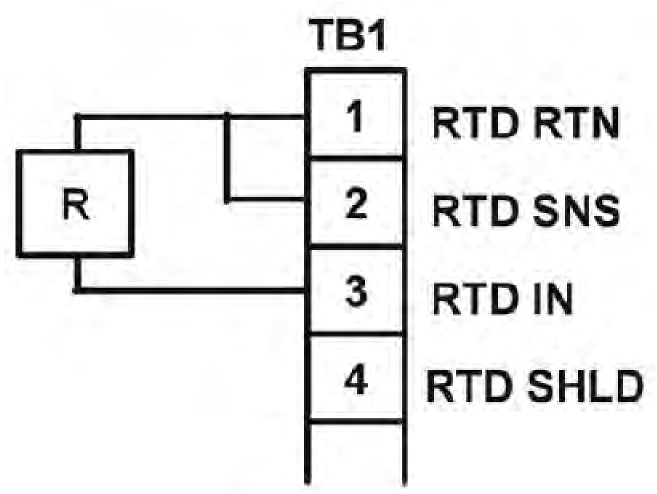


Although only two wires are required to connect the RTD to the transmitter, using a third (and sometimes fourth) wire allows the transmitter to correct for the resistance of the lead wires and for changes in the lead wire resistance with temperature.

11.7.2 Simulating temperature

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

Figure 11-4: Simulating RTD Inputs



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 transmitter 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 transmitter 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 transmitter 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 transmitter is working correctly.

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

12 Return of material

For any repair, warranty, and return of instrument requests, please contact the factory.

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