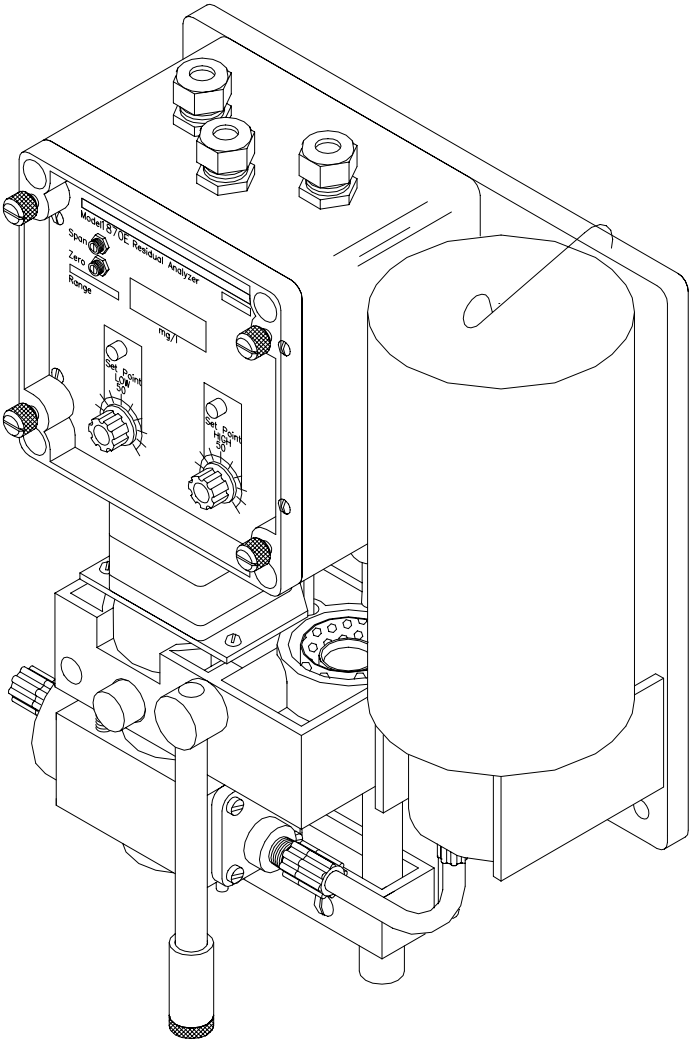


Instruction Manual — Series 1870E
Residual Analyzer



CAPITAL CONTROLS



These instructions generally describe the installation and maintenance of subject equipment. Capital Controls reserves the right to make engineering refinements that may not be described herein. Any questions not answered specifically by these instructions should be directed to your local sales representative or Capital Controls.

Capital Controls takes all possible precautions in packaging each item to prevent shipping damage. Carefully inspect each item and report damages immediately to the shipping agent for equipment shipped F.O.B. Colmar, or to Capital Controls for equipment shipped F.O.B. job site. Do not install any damaged equipment.

Follow all instructions on labels or tags. Carefully inspect all packing material before discarding to prevent loss of accessories, mounting hardware, spare parts or instructions.

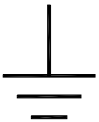
READ THE ENTIRE MANUAL BEFORE OPERATING



USE ONLY IN ACCORDANCE WITH INSTRUCTION MANUAL



WARNING: HAZARDOUS VOLTAGES



PROTECTIVE GROUND (EARTH) TERMINAL

WARNING: FAILURE TO INSTALL, SET UP OR OPERATE THE CONTROLLER IN THE MANNER SPECIFIED BY CAPITAL CONTROLS MAY IMPAIR THE PROTECTION PROVIDED BY THIS EQUIPMENT.

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1 INTRODUCTION

1.1 General Description

The Series 1870E Residual Analyzer/Indicator/Transmitter is an amperometric instrument designed to continuously analyze residual levels of free or total chlorine, chlorine dioxide and other oxidants in water, wastewater or other process water applications.

1.2 Specifications

Instrument Range: 0-0.1, 0-0.2, 0-0.3, 0-0.5, 0-1, 0-2, 0-3, 0-5, 0-10, 0-20 mg/l, field selectable without recalibration

Analyzer Location: As close as possible to the sample point to reduce sampling dead time

Display Resolution: 0.001 mg/l for 0-2 mg/l range and below 0.01 mg/l for 0-3, 0-5, 0-10, 0-20 mg/l ranges

Power Requirements: 100/120 Vac, 50/60 Hz, or 220/240 Vac, 50/60 Hz, single phase

Power Consumption: 16 VA

Output Signal: 4-20 mA_{dc} or 0-20 mA_{dc}, isolated into 800 ohms maximum, or 0-50 mV_{dc}

Relay Contacts:

10 amps @120 Vac, resistive load,

10 amps @24 V_{dc}, resistive load

5 amps @240 Vac, resistive load

Sample Flow: 500 ml/minute

Sample Pressure: 5 psig (0.3 bar) maximum at inlet point

Sample Supply: Continuous. Where sample interruption may be required, provisions must be made to keep the electrodes wet with fresh water.

Speed of Response: 4 seconds from sample entry to display indication. Full scale residual change 1 1/2 to 2 minutes.

Ambient Temperature: 32° to 120° F (0° to 50° C)

Sample Temperature Range: 32° to 120° F (0° to 50° C)

Sample: Samples containing high concentrations of metal ions or certain corrosion inhibitors may affect analyzer operation.

Electrode:

Cathode: Gold

Anode: Copper

Indicator: 3-1/2 digit, LCD display in milligrams per liter (mg/l)

Accuracy: 0.003 mg/l or ±1% of range, whichever is larger. (See Sample Limitations)

Sensitivity: 0.001 mg/l (1 ppb)

Controllability: Better than 0.01 mg/l or 2% of range, whichever is larger

Reagent Requirements:

Residual Measurement	Reagent Requirements
Chlorine (free)	pH buffer or CO2 gas
Chlorine (total)	pH buffer or CO2 gas and potassium iodide
Chlorine Dioxide	pH buffer and glycine
Bromine Chloride	pH buffer or CO2 gas and Potassium iodide
Bromine	pH buffer or CO2 gas and Potassium iodide
Iodine	pH buffer or CO2 gas

1.3 Principle of Operation

A sample liquid is delivered to the sample filtering chamber at an approximate rate of 500 ml/minute. The excess overflows to drain. The sample then passes through the annular space between the two fixed electrodes in the sensing cell. As it passes, a small direct current is generated in direct linear proportion to the amount of residual present in the sample. The surface of both electrodes are kept clean by the continuous action of PVC spheres agitated by a motor driven rotating striker.

This constant cleaning eliminates signal drift and recalibration, providing an accurate residual measurement. A thermistor compensates for sample temperature variations.

The residual value is displayed on the digital indicator in milligrams per liter (mg/l).

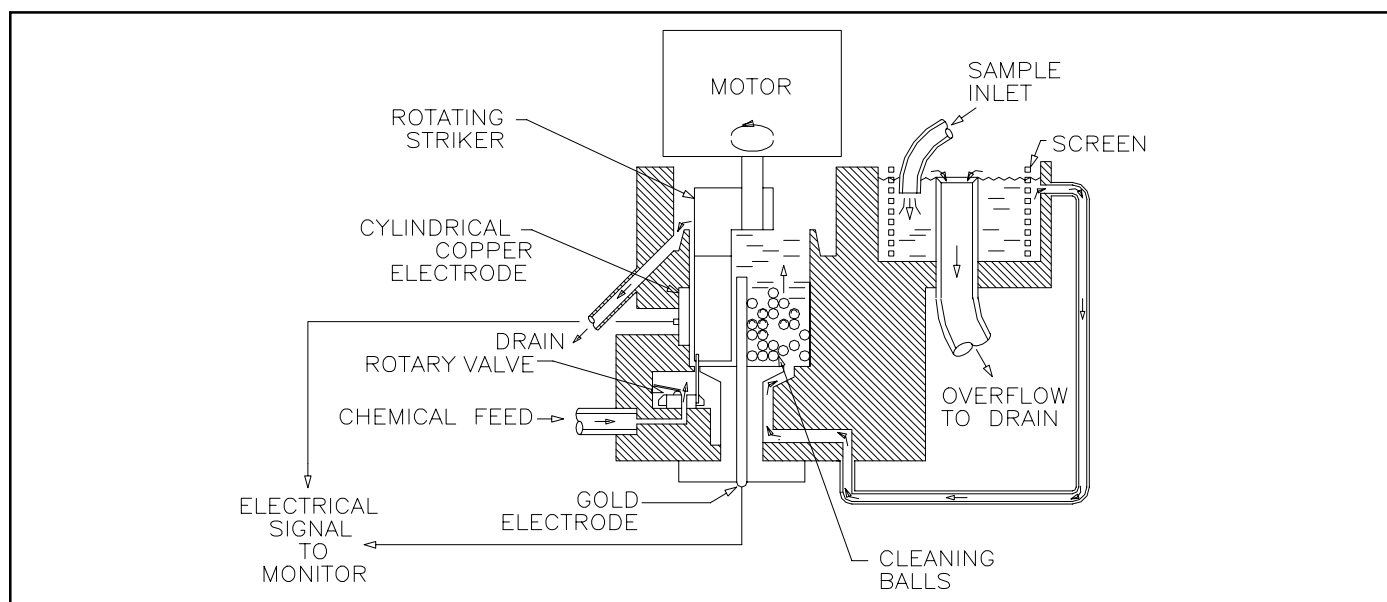


Figure 1 - Analyzer Flow Diagram

1.4 EMC Testing

This instrument has been evaluated for RF interference over a frequency range of 80-1000 MHz, and showed all overall acceptable immunity. However, it may show a low level of susceptibility (as a negative signal offset) to radio frequency emissions between 80 and 90 MHz. The intensity of the field strength at this frequency must exceed 2.5 Volts/meter (V/m).

Interference of any duration will not effect the instrument's performance unsafely at any frequency. Prolonged or intermittent operation under conditions of RF interference will not damage the instrument components, or cause any irreversible effects in the instrument's operation.

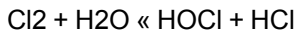
1.5 Reagent Feed System

Reagents are fed into the sensing cell to adjust pH and to permit measurement. The sample pH is adjusted by the buffer to a range of 4.0 to 4.5 pH. When CO₂ is used as a buffer, the pH will be lowered to a range of 5.5 or 6.0 pH. The addition of potassium iodide, when used, reacts to liberate free iodine in proportion to the total chlorine and provides a means of measurement.

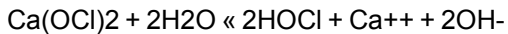
NOTE: The buffer feed system is designed to feed enough buffer for water which is difficult to buffer. If your sample water is easily buffered it is possible to dilute the buffer with distilled water in order to save chemical costs. Care must be taken when diluting the buffer not to dilute so much that the pH in the sample cell rises above 5.0. This is best done by gradually diluting the buffer a little more each time the reagent bottle is refilled until the pH in the cell rises to 4.8.

1.6 Chlorine Chemistry

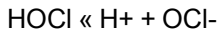
As chlorine dissolves in water, hypochlorous acid (HOCl) and hydrochloric acid (HCl) are formed according to the following equation:



Hypochlorous acid may be formed with the addition of hypochlorite [e.g. sodium hypochlorite (NaOCl) or calcium hypochlorite (Ca(OCl)₂)] to water.



Hypochlorous acid is a weak acid, only partially dissociating into hydrogen and hypochlorite ions.



The degree of dissociation (or ionization) of hypochlorous acid is affected by pH and temperature. With decreasing pH, the degree of dissociation of hypochlorous acid decreases. Below a pH of 5.0, the dissociation of hypochlorous acid is virtually 0%, regardless of temperature. As temperature increases or decreases, the dissociation curve shifts along the pH axis. See Figure 2.

The sum of hypochlorous acid and hypochlorite ion in solution is called "free available chlorine".

If ammonia-nitrogen is present in water that is being chlorinated, further reactions can occur between ammonia-nitrogen and hypochlorous acid to form chloramine compounds. Chloramines are called "combined available chlorine".

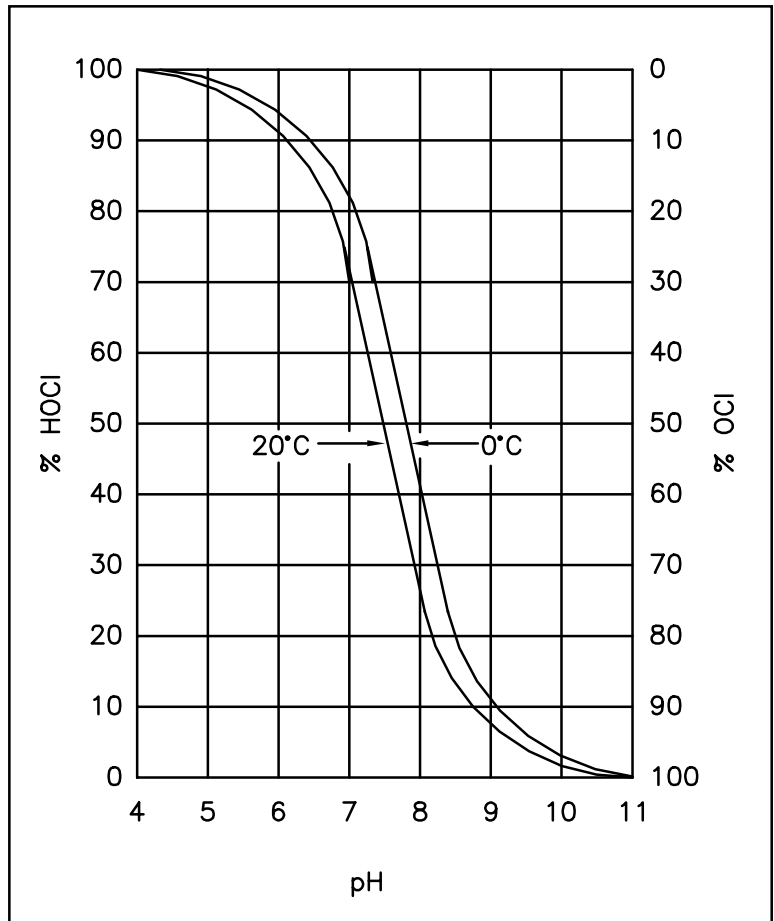


Figure 2 - Dissociation Curve

The sum of free and combined available chlorine is defined as total available chlorine.

When potassium iodide (KI) is added to a solution containing total available chlorine, all chlorine species react to form free iodine. The electrochemistry of iodine in water is similar to chlorine, and it is therefore measured by the analyzer. The following equations show the chemistry of the reaction:

Free chlorine residual:



Chloramines or combined available chlorine:



The reaction of available chlorine with KI is also the basis of the iodometric method of chlorine analysis.

1.7 Galvanic Cell Theory

Water, in pure form, is relatively nonconductive, but addition of an ionizing species (e.g. salt) allows current to pass. The greater the concentration of ions in solution, the greater the conductance of the solution.

If two electrodes are immersed in an ion containing solution, a chemical species capable of being reduced (gaining electrons) can move toward the cathode where electrons are transferred from the cathode to the reducible species, resulting in a cathodic current.

At the same time, an oxidation reaction (where an oxidizable species loses electrons) occurs at the anode. Electrons are then transferred to the anode, producing an anodic current.

As the reaction occurs at the cathode, the concentration of the reducible species at the cathode drops. In response to the resultant concentration gradient created, more of the reducible species moves toward the cathode. This is referred to as diffusion. The speed of movement of the reducible species toward the cathode is called the rate of arrival.

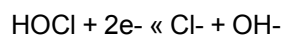
The rate that the reducible species arrives at the cathode is dependent on its concentration. As the concentration increases the diffusion to the cathode increases, which increases the current.

The current is also affected by temperature. With elevated temperatures, diffusion increases. Most systems compensate for temperature in some fashion.

If the electrodes are made of two (selected) dissimilar metals and the proper conditions exist with regard to solution composition, current can be produced by simply connecting (shorting) the electrodes. This type of cell is called a galvanic cell.

In a galvanic cell, a change in concentration is detected by measuring the change in current flowing through the cell. The cell current responds proportionally to changes in concentration.

The cathode in the galvanic cell used in the 1870E Chlorine Analyzer is gold. When hypochlorous acid (or hypochlorite ion) is present in solution, electrons are exchanged at the cathode surface and chloride ions are produced.



The anode is copper. As electrons are exchanged, an oxide product remains on the anode. Because of this, an abrasion mechanism (constant stirring of cleaning spheres) is incorporated to strip the oxide product off the metal surface. Since copper is consumed in the process, the term sacrificial anode is applied to the copper electrode.

Current flow in the amperometric cell is affected by changes in pH. The cell current is most stable between 4 and 4.5 pH, therefore, a pH buffering solution is used in the cell to stabilize the cell current.

Temperature compensation circuitry is employed to counter the affects of diffusion and other factors that are affected by temperature.

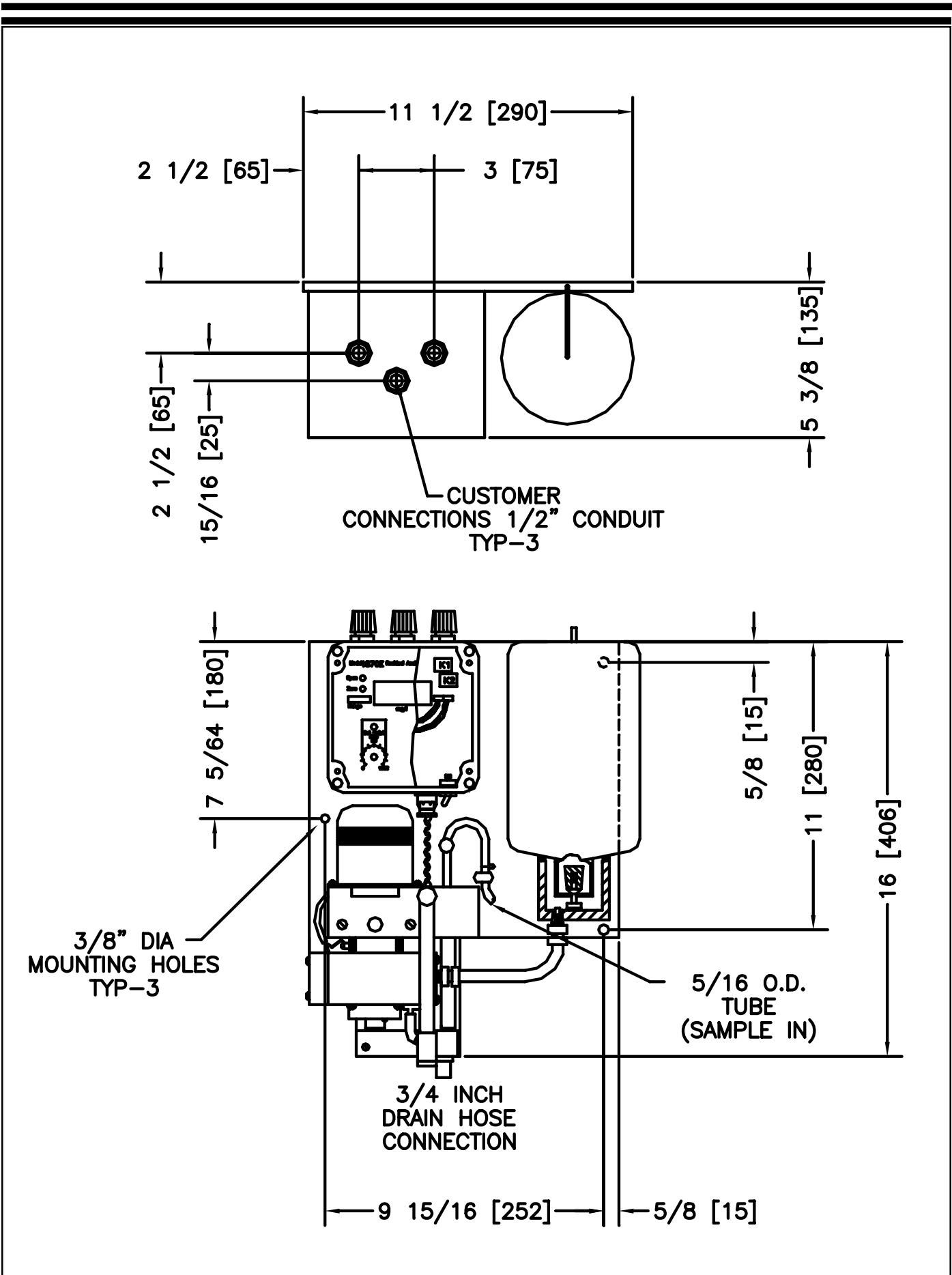
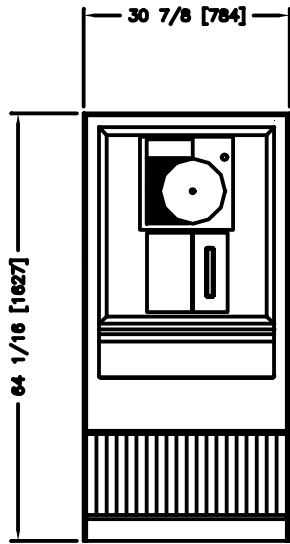
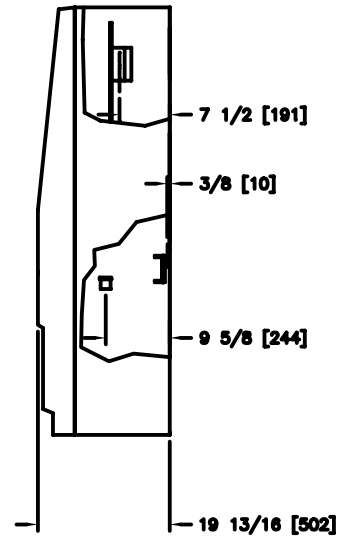


Figure 3 - Wall Mounting Dimensions

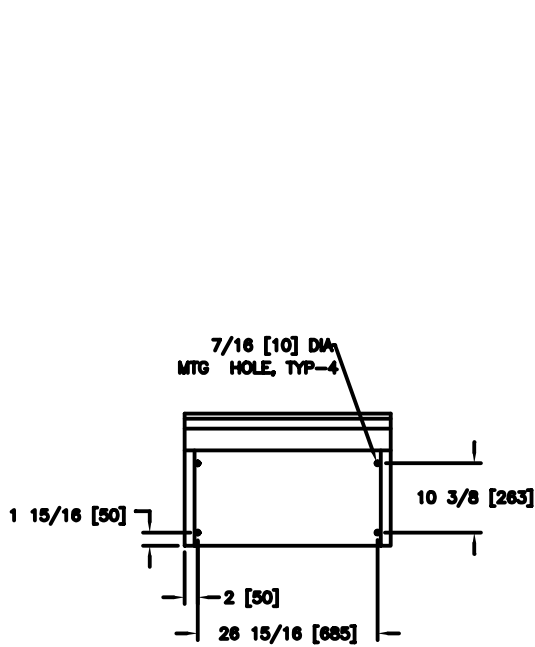
2 INSTALLATION



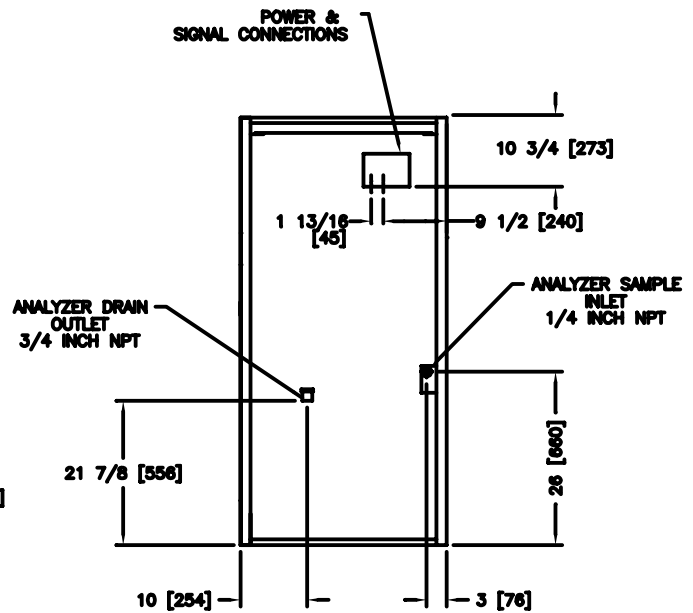
FRONT VIEW



SIDE VIEW



BOTTOM VIEW



REAR VIEW

Figure 4A - Floor Cabinet Mounted Residual Analyzer Dimensions

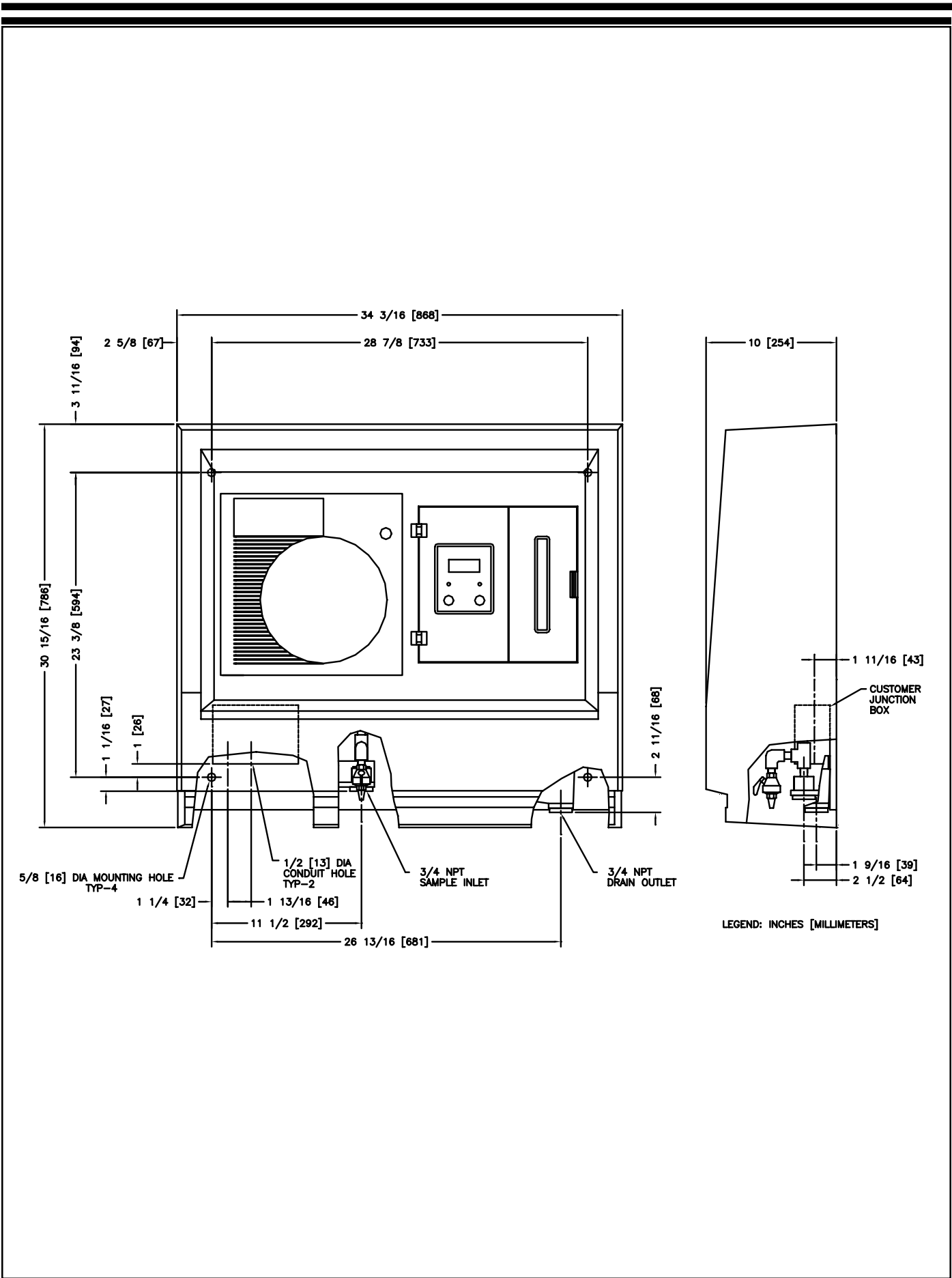


Figure 4B - Wall Cabinet Mounted Residual Analyzer Dimensions

2.1 General

The Series 1870E Residual Analyzer is designed for a multitude of applications. This instrument will provide unparalleled accuracy for drinking water, wastewater, cooling water, beverage, industrial effluent, RO membrane, and process control applications or any application where highly accurate chlorine detection and control are necessary. The tasks described in this section require that individuals be technically knowledgeable and aware of proper safety procedures. Individuals must adhere to all applicable electrical and plumbing codes.

2.1.1 Unpacking

Remove the instrument from its packing container and carefully inspect each item and report damages immediately. Be sure that the following items were included in the carton:

Series 1870E Chlorine Residual Analyzer (receiver, wet end on a backboard and reagent bottle)

Instruction Manual

2.1.2 Environmental Requirements

The instrument is designed for general duty indoor installation. Outdoor installation is possible if the instrument is shielded from dripping water and not mounted in direct sunlight. Ambient temperatures should range from 32°F to 140°F (0°C to 60°C) with sample temperatures from 32°F to 120°F (0°C to 50°C).

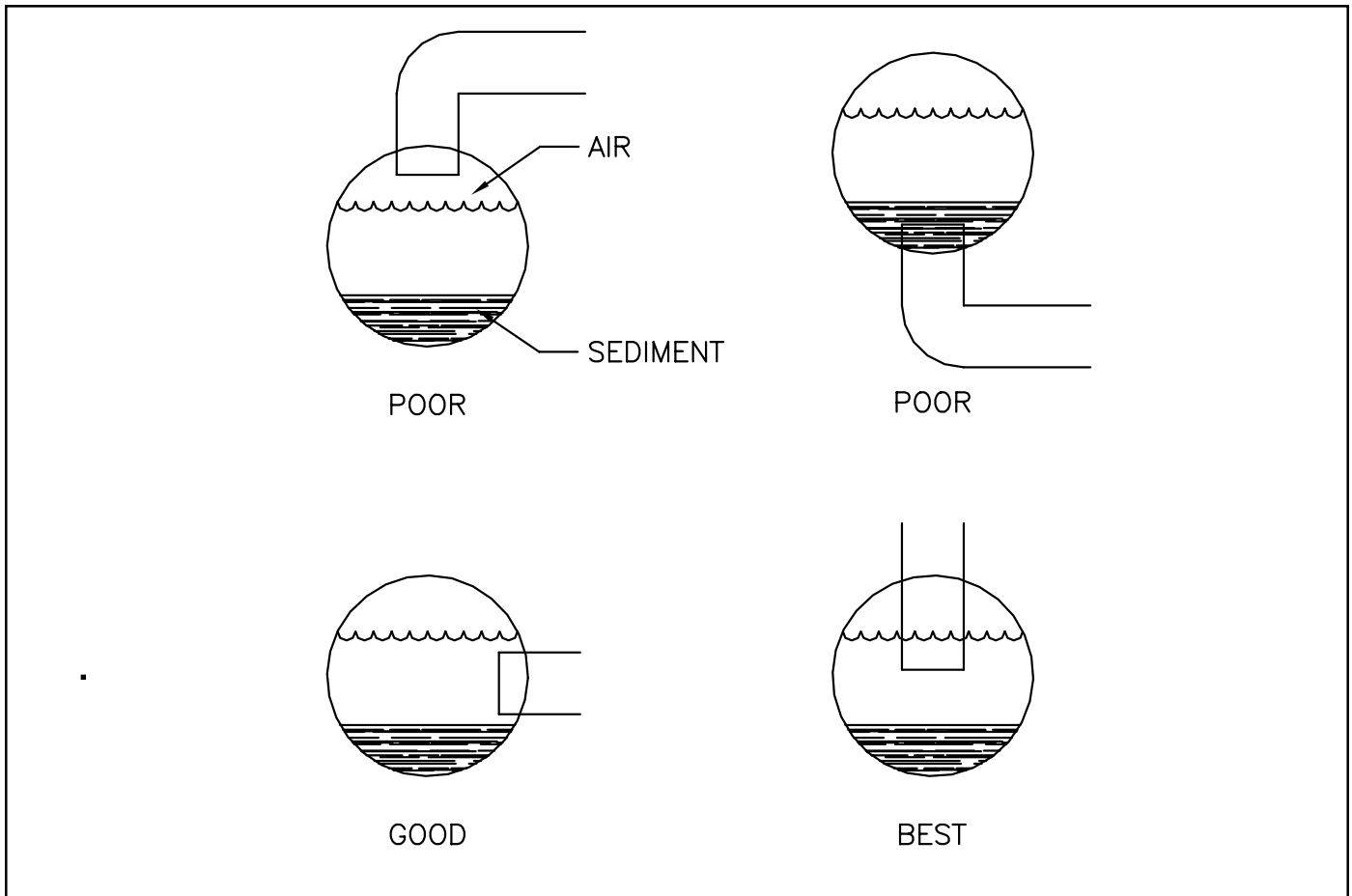


Figure 5 - Sample Line Taps

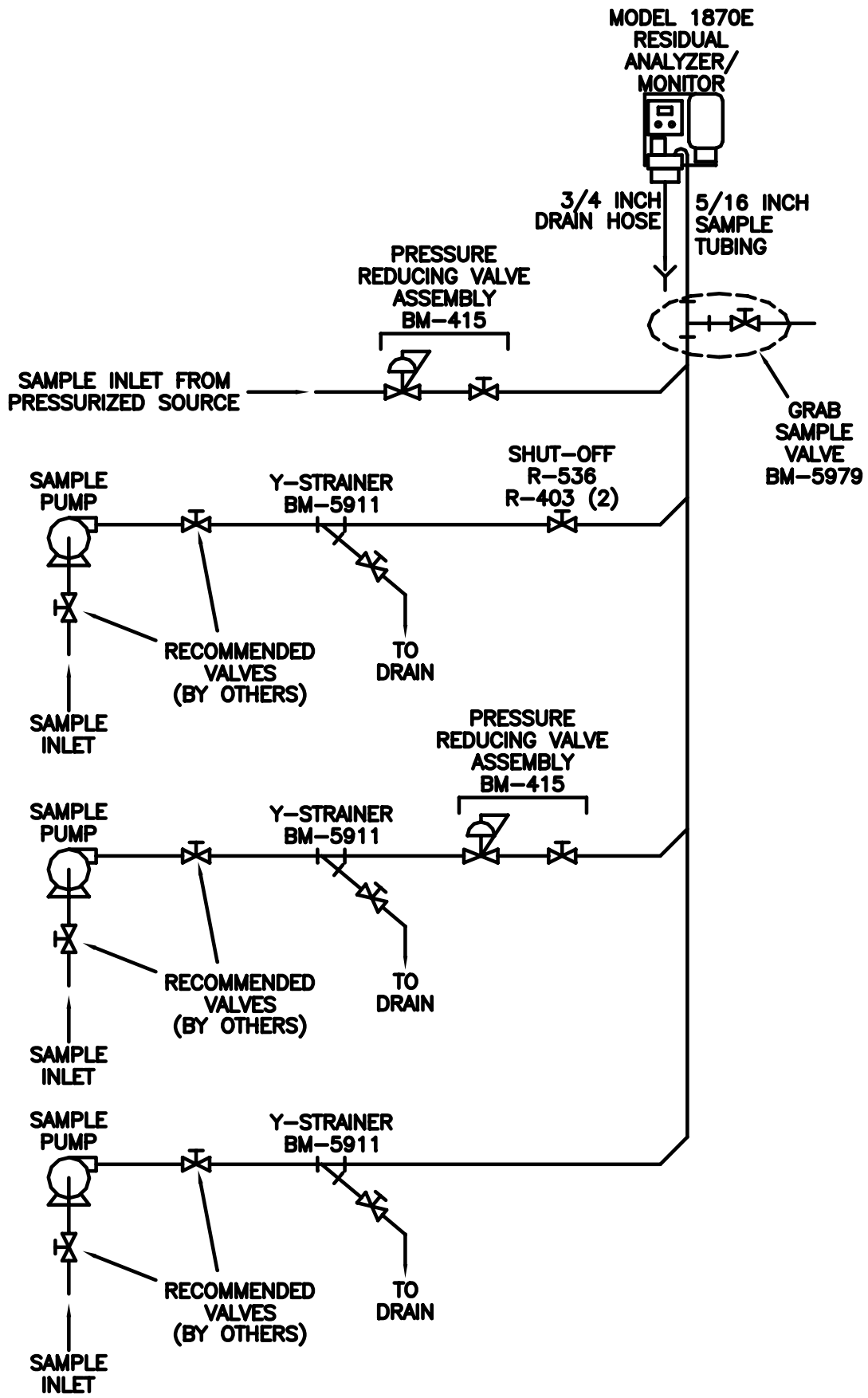


Figure 6 - Plumbing Configuration

2.1.3 Location

In order to obtain optimum performance from the Series 1870E Residual Analyzer, selection of a good, representative sampling point is critical. If a sampling point is too close to the chlorine feed, inadequate mixing, or incomplete chlorine/sample reaction may occur. The sampling point should be where the sample and chlorine is reacted and mixed thoroughly so the analyzer is indicating the representative residual chlorine being carried throughout the water system.

All residual analyzers should be located as close to the sampling point as possible to reduce sample dead time. Sampling lines should be run with small diameter tubing to minimize the lag time.

The electronic enclosures are designed to protect the electronics from typical conditions in water/wastewater treatment or industrial facilities.

2.2 Mounting

2.2.1 Wall Panel

Dimensional drawings are given to aid installation and to determine the position of mounting holes. Figure 3.

- a. Remove the reagent bottle to gain access to the three (3) mounting holes. The clip securing the reagent bottle should be lifted and rotated 90° to release the bottle.

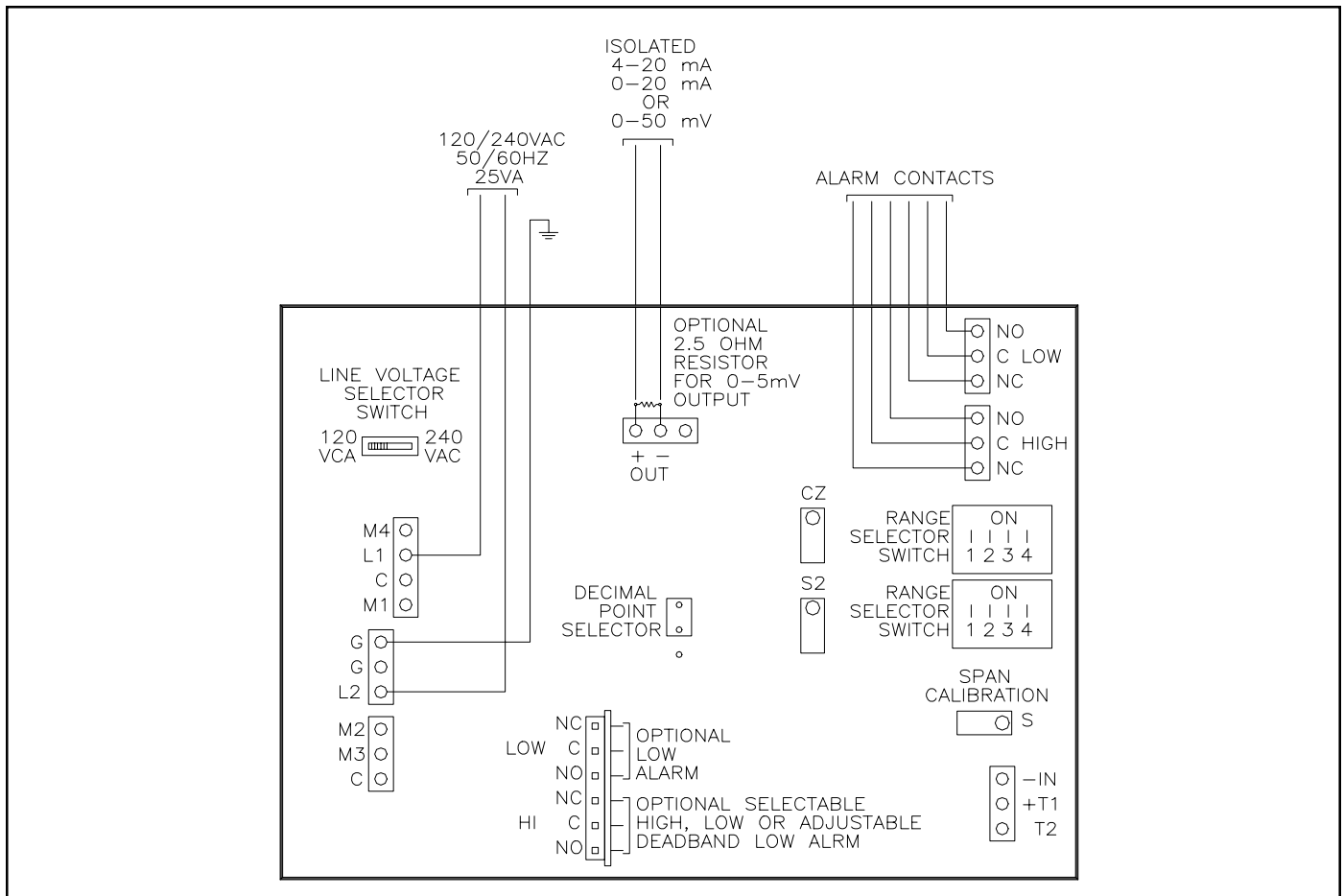


Figure 7 - Wiring Diagram

- b. Position the analyzer panel on a wall at eye level and as close as possible to the sample source. Secure with 1/4" bolts, leveling the analyzer before securing.

2.2.2 Cabinet Mounting

- a. All hydraulic and electrical connections are made at the cabinet using bulkhead fittings and an electric junction box.
- b. Refer to the Cabinet Instruction Manual for installation details.

2.3 Hydraulic Connections (Wall Panel Only)

2.3.1 Procedure

- a. Connect a length of 3/4" drain hose to the drain outlet on the analyzer. Secure with a 3/4" hose clamp. Route the hose to maintain a gravity fed drain (downward slope).
- b. Connect one end of the 5/16" sample supply tubing to the source using the 1/4" NPT connector. Route the tubing to the sample filter chamber through the two (2) tubing holders on the analyzer panel. Position the end of the tubing between the filter chamber and below the top of the overflow weir (See Figure 11. Note the proper position of the overflow weir.) Do not direct water flow to the center of the overflow weir. The maximum desired pressure for the flow is about 5 psig (0.3 bar). The sample tubing is rated to 55 psig (3.8 bar).

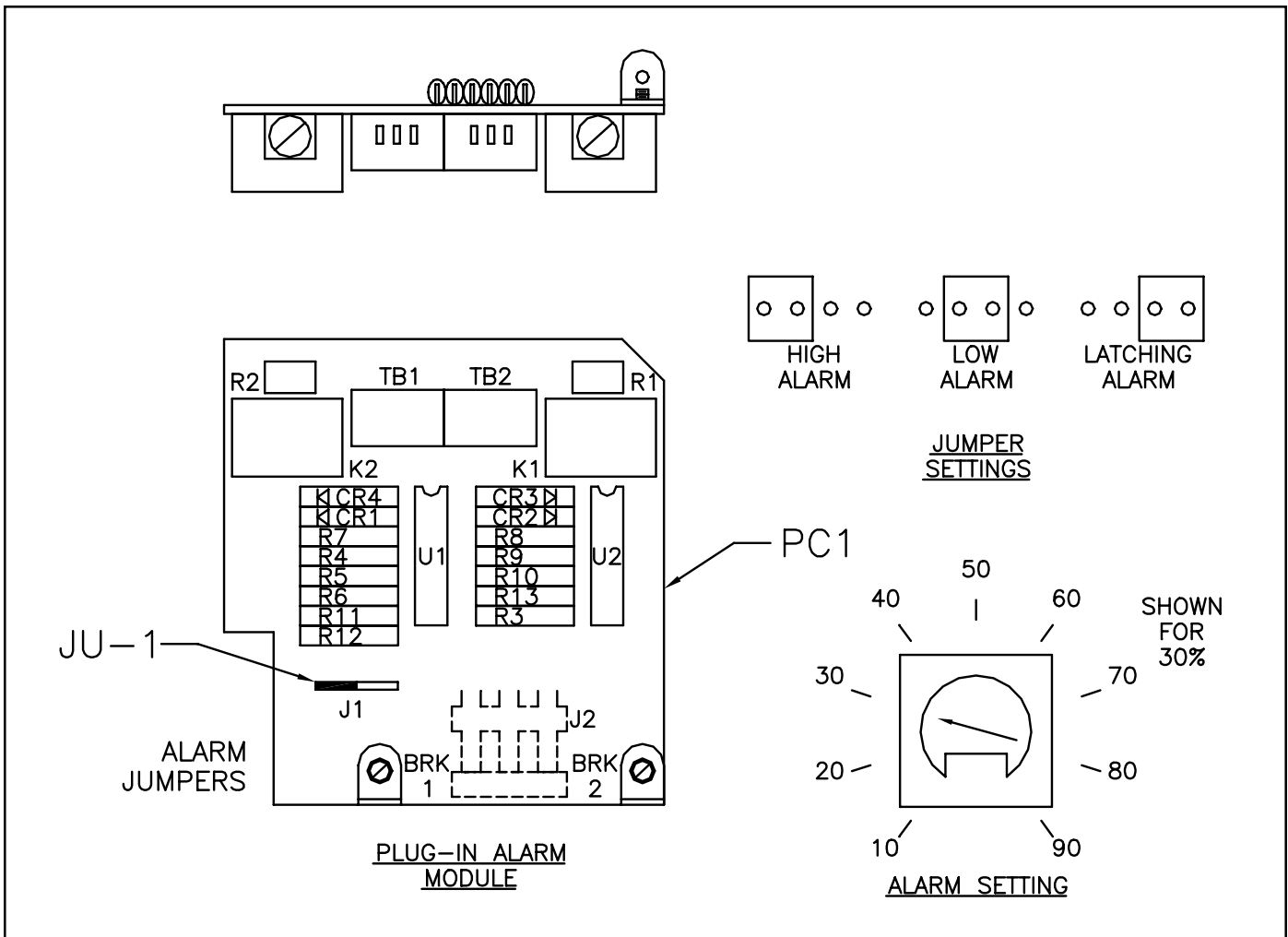


Figure 8 - High/Low Latching Alarms

2.3.2 Sample Line Taps

Sample line taps into larger pipes should be installed to minimize the chances of air bubbles or sediment entering the analyzer. A tap should project into the center of the line. Figure 5.

2.3.3 Sample Flow

A typical installation may require a sample pump if the pressure is low and/or a Y-strainer to remove any particulates. There may also be a need for a pressure reducing valve if the sample pressure is too high or the sample pump needs to be regulated. Figure 6

2.4 Electrical

NOTE: All wiring must comply with applicable local and national electrical codes.

2.4.1 Wall Panel Mounted Conduit Connections

- a. Remove four (4) screws securing the clear cover and remove the cover.
- b. Remove four (4) screws securing the face plate. Remove the face plate.
- c. Set the line voltage Selector Switch to the proper voltage. If necessary, remove the plastic strap on the switch. See Figures 7 and 19.
- d. Route the power line from the analyzer to the power supply through the top opening.
- e. Connect the power wiring to the L1, L2, and G terminals. See Figure 7.
- f. Connect current output and alarm contacts, **NOTE:** Do not run line voltage and low level signal voltage in the same conduit. See Figure 7.
- g. Replace face plate and clear cover.

NOTE: For electrical connections in cabinet mounted analyzers, refer to Cabinet Instruction Manual.

2.5 Set Points

High and low set point adjustment knobs are located on the front of the unit. To set the alarm points, proceed as follows:

2.5.1 Alarm

Verify the factory-applied range sticker corresponds with the range selected. If the range is not indicated, is incorrect or missing, select the correct sticker, included with your unit, and place it on the front of the unit in the space provided. In order to establish your set points, you must know the instrument's range.

- a. Determine the high and low milligram per liter value at which you want the analyzer to alarm. To figure these percentages, use the following formula:

$$\text{Alarm point range} \times 100 = \% \text{ set point}$$

- b. Set the low set point to the percentage value for the low alarm point and the high set point to the percentage value for the high alarm point.

2.5.2 High/Low/Latching Alarms

The high/low/latching alarms are a field mountable option. Refer to Figures 7, 8, and 20 and plug the alarm board into the J3 receptacle on the main printed circuit board. Secure with the two (2) 4-40 X 1/4" screws supplied.

The alarm module has one low alarm and one alarm which can be selected as a high, low or latching (adjustable deadband) alarm/control by setting the jumper as shown in Figure 8. Jumper positions are located in the lower left portion of the alarm board.

Use the slot on the potentiometer to indicate approximate set point.

Relay contacts are SPDT, 10 amps at 250 Vac or 60 Vdc. Relays are de-energized during normal operation and energized during alarm conditions.

a. Operation - Latching Mode

When the incoming signal is below the LOW set point, the K1 relay will energize and remain energized until the signal increases above the HIGH K1 set point. The relay will de-energize and remain off until the signal drops below the LOW set point.

When the latching mode is selected, the K1 control is used to set the HIGH drop-out point, and the LOW control is used to set the LOW pull-in point, with both controls operating the K1 relay. The LOW relay will still function and will trip at the LOW control setting.

The latching mode is used where it is desired to begin chemical feed at some low point and continue feeding until the selected higher point is reached.

START-UP

3.1 Range Selection (Refer to Figure 19)

Select the instrument range, per Table I, via the DIP switches and jumper plug found on the printed circuit board. Ranges can be changed by resetting the DIP switches and the decimal point jumper plug (where necessary). Zero and span recalibrations are not necessary.

For measuring chlorine, S3-4 (DIP package S3, switch number 4) switch should be OFF. For all other measurements, S3-4 should be ON. If ranges are changed, the paste on labels on the front plate must also be changed, using the labels provided.

Table I - Range Selection

Range mg/l	DIP SWITCHES						Decimal Point Jumper Plug	Maximum Display
	S3			S4				
	1	2	3	2	3	4		
0-0.1	OFF	ON	OFF	OFF	ON	OFF	<input type="radio"/> <input type="radio"/> <input type="radio"/>	2.000 MG/L
0-0.2	ON	OFF	OFF	OFF	ON	OFF		
0-0.3	OFF	OFF	OFF	OFF	ON	OFF		
0-0.5	OFF	OFF	ON	ON	OFF	OFF		
0-1	OFF	ON	OFF	ON	OFF	OFF		
0-2	ON	OFF	OFF	ON	OFF	OFF		
0-3	OFF	OFF	OFF	OFF	OFF	OFF	<input type="radio"/> <input type="radio"/> <input type="radio"/>	20.0 MG/L
0-5	OFF	OFF	ON	ON	OFF	ON		
0-10	OFF	ON	OFF	ON	OFF	ON		
0-20	ON	OFF	OFF	ON	OFF	ON		

3.2 Measuring Chlorine (free) and Iodine

3.2.1 Reagents

A pH buffering solution or carbon dioxide gas is required for analyzer operation. The 2-liter reagent bottle provides approximately a 1-week supply. A premixed pH buffer solution (A-1806) is available from Capital Controls or the buffer solution may be prepared by mixing the dry chemicals.

NOTE: Never disable unit without removing the reagent bottle and flushing with clean water until all chemical is removed. Failure to use or mix buffer as outlined may void product warranty.

WARNING: Buffer solution contains glacial acetic acid, which is corrosive. Avoid contact with skin and eyes and breathing of vapor. Use rubber gloves and safety glasses when handling buffer solution, mixing with other reagents, or changing the reagent bottle. Use only with adequate ventilation (i.e. under a fume hood). Only an acetic acid based (concentrated) pH 4 buffer should be used. The use of other buffers may cause improper analyzer operation. If solution comes into contact with eyes, flush the affected area with water for 15 minutes. Get medical attention. If solution is swallowed, call physician immediately. Do **NOT** induce vomiting. Give large amounts of water containing milk of magnesia, followed with raw white of eggs beaten with water.

3.2.2 Mixing Dry Chemicals

If you are not using the premixed buffer solution, then it is necessary to make a buffer solution as follows:

- Using a 1 gallon (3.8 liter) bottle, fill the bottle 1/2 full with distilled or deionized water.
- Add 920 grams sodium acetate trihydrate crystals and mix until all the crystals are dissolved.
- Add 1800 grams or 1730 ml glacial acetic acid.

- d. Fill bottle to the top with distilled or deionized water and shake to thoroughly mix solution. Pour into the analyzer reagent bottle.
- e. The result is a buffer solution the same composition as the premixed buffer.

3.2.3 Buffer Preparation

NOTE: This is the recommended buffer preparation procedure.

- a. Using a 1 gallon (3.8 liter) bottle, add 2 quarts (1.9 liters) of either the premixed buffer (3.2.1) , or the prepared buffer (3.2.2).
- b. Fill the bottle to the top with distilled or deionized water and shake the bottle to thoroughly mix.
- c. Pour into the analyzer reagent bottle.

3.2.4 Carbon Dioxide (CO₂) Gas

When using carbon dioxide gas for pH buffering, a carbon dioxide gas flow rate of 175 cubic centimeters per minute, at 1 psig is required. Install the regulated gas flow line as follows:

- a. Wall Panel Mounted

Run a regulated carbon dioxide gas flow line to the inlet fitting mounted on the lower right side of the analyzer cell. (Refer to Figure 9).

- b. Wall or Floor Cabinet Mounted

Run a regulated carbon dioxide gas flow line to the bulkhead connector on the inlet side of the cabinet.

- c. Procedure for using A-1730-1 CO₂ Regulator:

- 1. Turn off power and water supply to the analyzer and open all analyzer drains.

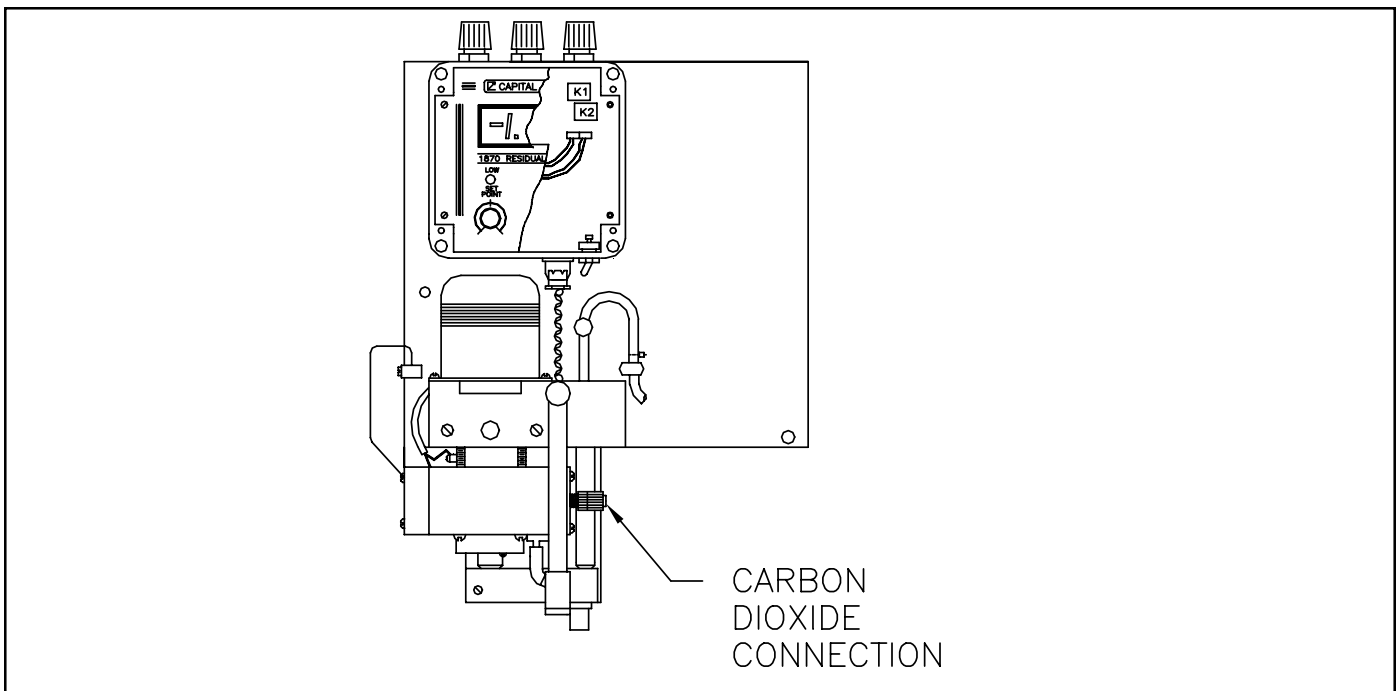


Figure 9 - Carbon Dioxide Inlet Fitting Analyzer Without Reagent Bottle

2. Mount the pressure regulator on the carbon dioxide cylinder and connect it to the diffuser assembly inlet with 3/8" tubing. (see Figure 10)
3. Restore power and water to the analyzer and check for leaks.
4. Slowly open the carbon dioxide cylinder valve and check for leaks. Turn off the carbon dioxide and immediately repair any leaks. Confirm that inlet pressure gauge indicates a pressure rise.
5. Adjust the regulator and rate valve to obtain a flow of approximately 0.25 PPD (50 ccm) of carbon dioxide and check for gas leaks with soap solution. Check all tubing connections at the cylinder, regulator, and analyzer and repair any leaks.
6. Turn pressure regulator adjusting screw clockwise until outlet pressure indicates 10 psi.
7. Adjust the flow rate valve to achieve a flow rate of 175 cubic centimeters per minute. (this is equivalent to 1 PPD at 1 psi at the analyzer inlet).
8. A constant pH should be maintained between 5.0 and 6.0

Clarify CO2 requirements to indicate a carbon dioxide gas flow rate of 175 cubic centimeters per minute is required at 1 psi.

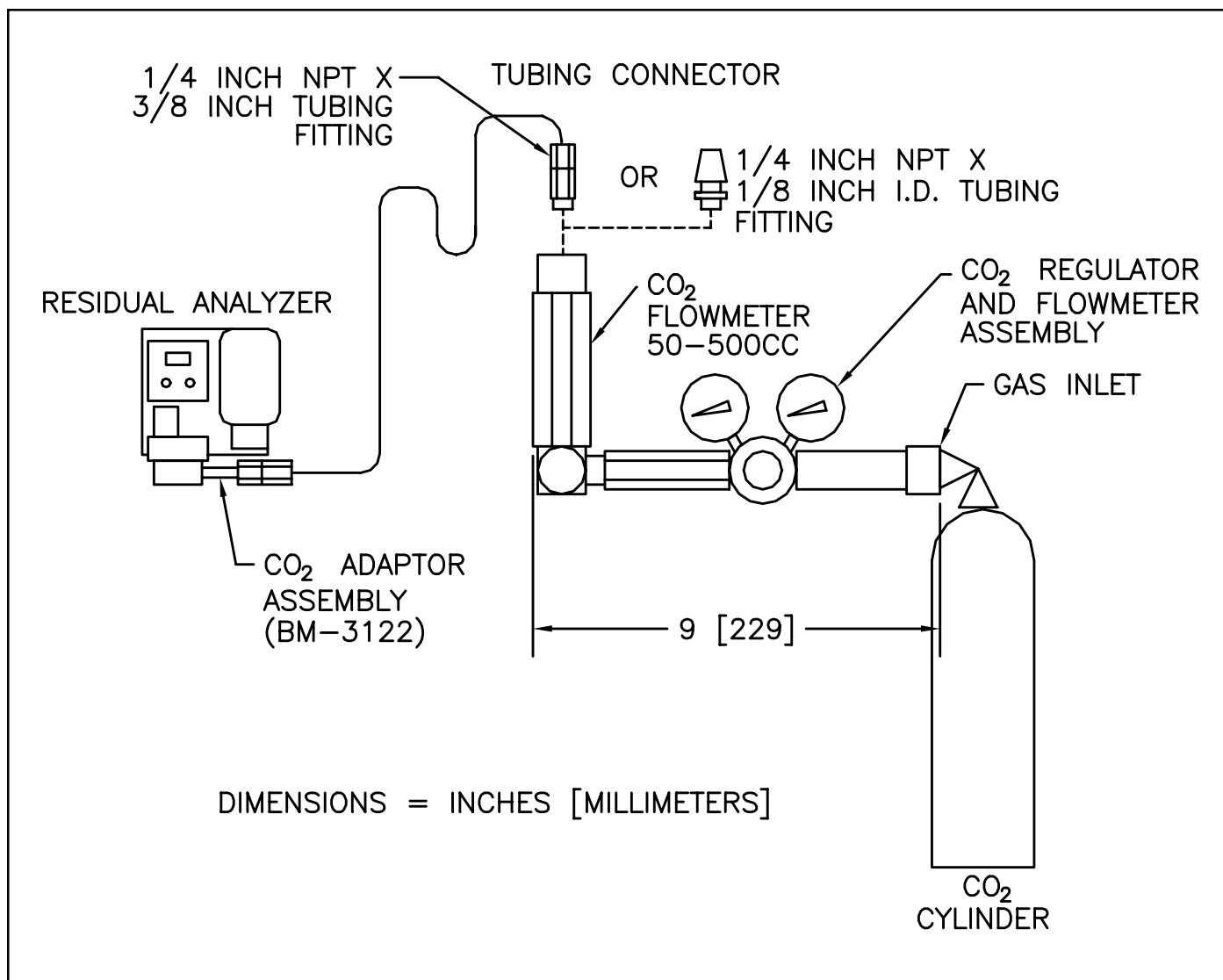


Figure 10 - Carbon Dioxide Regulator Assembly Installation

3.3 Measuring Chlorine (total), Bromine Chloride, Bromine

3.3.1 Reagents

A pH buffering solution or carbon dioxide gas, plus potassium iodide are required for analyzer operation. A premixed pH buffer solution (A-1806) is available from Capital Controls, or the buffer solution may be prepared by mixing the dry chemicals.

3.3.2 Mixing Dry Chemicals

NOTE: Never disable unit without removing the reagent bottle and flushing with clean water until all chemical is removed.

WARNING: The buffer solution contains glacial acetic acid, which is corrosive. Avoid contact with skin and eyes and breathing of vapor. Use rubber gloves when handling buffer solution, mixing with other reagents, or changing the reagent bottle. Use only with adequate ventilation (i.e. under a fume hood). Only an acetic acid-based (concentrated) pH 4 buffer should be used. The use of other buffers may cause improper analyzer operation. If solution comes into contact with eyes, flush the affected area with water for 15 minutes. Get medical attention. If solution is swallowed, call physician immediately. Do NOT induce vomiting. Give large amounts of water containing milk of magnesia, followed with raw whites of eggs beaten with water.

- a. Using a 1 gallon (3.8 liter) bottle, fill the bottle 1/2 full with distilled or deionized water.
- b. Add potassium iodide crystals (part number R-410, available from Capital Controls) as follows to the 1/2 full gallon bottle:

Potassium Iodide (KL)(grams)	Analyzer Range (mg/l)
5	0-0.2
10	0-0.5
40	0-2.0
60	0-3.0
100	0-5.0
200	10 and 20

- c. Shake until crystals are completely dissolved.
- d. Add 460 grams sodium acetate trihydrate crystals and mix until all the crystals are dissolved.
- e. Add 900 grams or 865 ml glacial acetic acid.
- f. Fill the gallon bottle to the top with distilled or deionized water and shake again. Pour into the reagent bottle through a fine strainer.

3.3.3 Using the Premixed Buffer Solution

To prepare the reagent solution using the premixed buffer from Capital Controls:

- a. Pour 1/4 liter of the premixed pH 4 buffer solution into the analyzer reagent bottle.
- b. Add potassium iodide crystals as follows to the reagent bottle:

Potassium Iodide (KI)(grams)	Analyzer Range (mg/l)
5	0-0.2
10	0-0.5
40	0-2.0
60	0-3.0
100	0-5
200	0-10
400	0-20

- c. Shake the solution until the crystals are completely dissolved.
- d. Fill the reagent bottle to the top with more premixed pH 4 buffer solution.
- e. Shake thoroughly.

NOTE: Due to the nature of potassium iodide (KI), the oxidizing of the solution limits the life of the KI in solution to 15 days. Add 1 drop of a reducing agent such as 0.02N sodium thiosulfate or 0.00564N phenylarsine oxide to the reagent bottle 14 days after the solution has been mixed. Oxidation of the KI in solution is characterized by golden color. By adding the reducing agent, the solution will return to clear. If the solution turns from a golden color to dark brown or black color, the potassium iodide has oxidized, and a fresh bottle of buffer solution should be prepared.

3.3.4 Carbon Dioxide Gas

When using carbon dioxide gas for pH buffering, a carbon dioxide gas flow rate of 200 cubic centimeters per minute is required at 1 psig. Install the regulated gas flow line as follows:

- a. Wall Panel Mounted - Run a regulated carbon dioxide gas flow line to the inlet fitting mounted on the lower right side of the analyzer cell. (Refer to Figure 11).
- b. Wall or Floor Cabinet Mounted - Run a regulated carbon dioxide gas flow line to the bulkhead connector on the inlet side of the analyzer cabinet.
- c. Procedure for using A-1730-1 CO2 Regulator:
 1. Turn off power and water supply to the analyzer and open all analyzer drains.
 2. Mount the pressure regulator on the carbon dioxide cylinder and connect it to the diffuser assembly inlet with 3/8" tubing. (see Figure 10)
 3. Restore power and water to the analyzer and check for leaks.
 4. Slowly open the carbon dioxide cylinder valve and check for leaks. Turn off the carbon dioxide and immediately repair any leaks. Confirm that inlet pressure gauge indicates a pressure rise.
 5. Adjust the regulator and rate valve to obtain a flow of approximately 0.25 PPD (50 ccm) of carbon dioxide and check for gas leaks with soap solution. Check all tubing connections at the cylinder, regulator, and analyzer and repair any leaks.
 6. Turn pressure regulator adjusting screw clockwise until outlet pressure indicates 10 psi.
 7. Adjust the flow rate valve to achieve a flow rate of 175 cubic centimeters per minute. (this is equivalent to 1 PPD at 1 psi at the analyzer inlet).
 8. A constant pH should be maintained between 5.0 and 6.0
- d. Using a 1 gallon bottle, add 2 quarts distilled or deionized water.
- e. Add potassium iodide crystals (part number R-410, available from Capital Controls) as follows to the 1/2 full gallon bottle:

Potassium Iodide (KI)(grams)	Analyzer Range (mg/l)
5	0-0.2
10	0-0.5
40	0-2.0
60	0-3.0
100	0-5.0
200	10 and 20

- f. Shake until crystals are completely dissolved.
- g. Fill the 1 gallon (3.8 liter) bottle to the top with distilled or deionized water and shake again.
- h. Pour into the analyzer reagent bottle through a fine strainer.

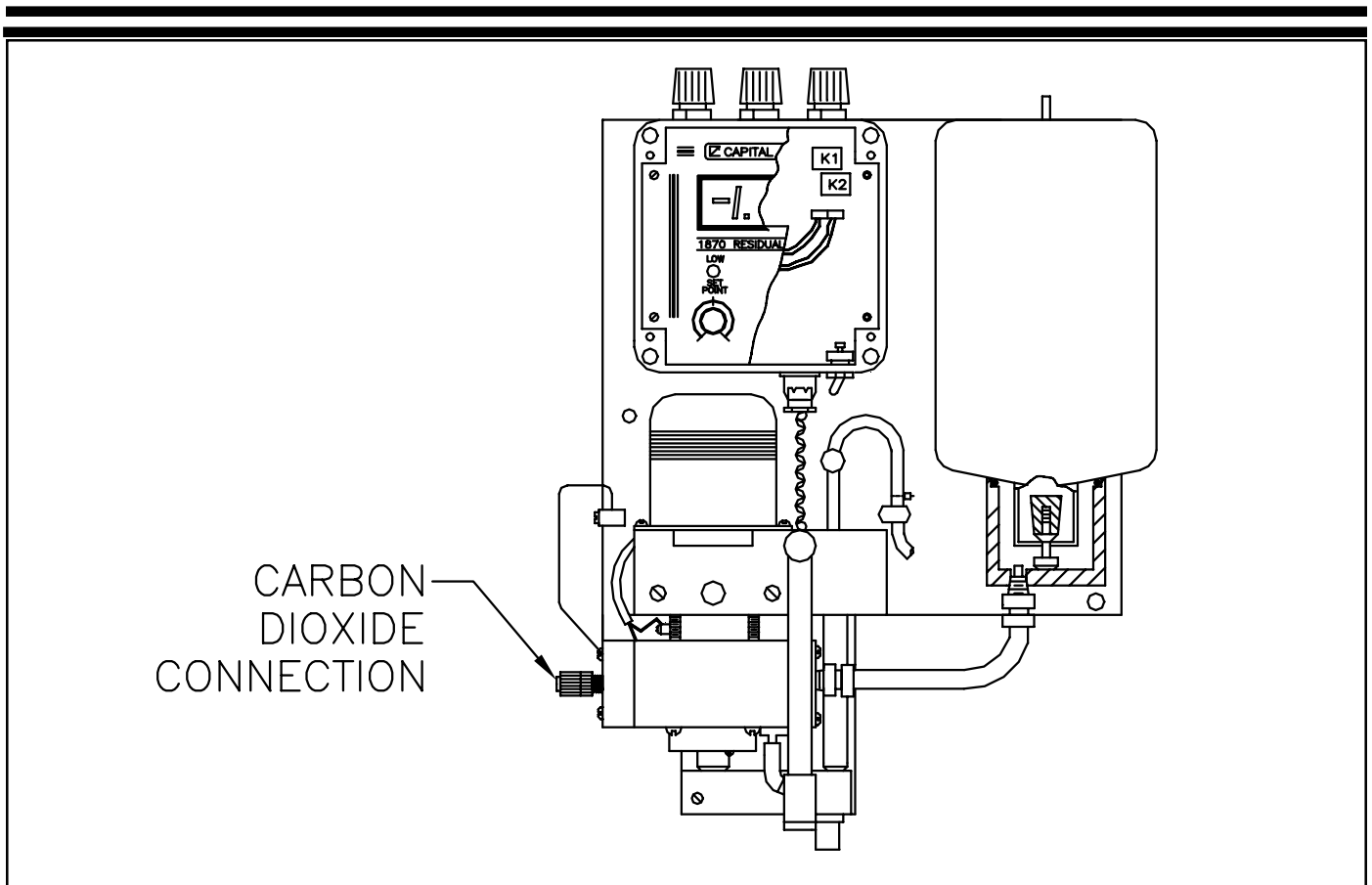


Figure 11 - Carbon Dioxide Inlet Fitting Analyzer With Reagent Bottle

3.4 Measuring Chlorine Dioxide

3.4.1 Reagents

A pH buffering solution or carbon dioxide gas is required for analyzer operation. In addition, glycine is required. Only an acetic acid-based (concentrated) pH 4 buffer should be used. The use of other pH 4 buffers may cause improper analyzer operation. Consult factory. A premixed pH buffer solution (A-1806) is available from Capital Controls, or the buffer solution may be prepared by mixing dry chemicals.

NOTE: Never disable unit without removing the reagent bottle and flushing with clean water until all chemical is removed.

WARNING: The buffer solution contains glacial acetic acid, which is corrosive. Avoid contact with skin and eyes and breathing of vapor. Use rubber gloves when handling buffer solution, mixing with other reagents, or changing the reagent bottle. Use only with adequate ventilation (i.e. under a fume hood).

3.4.2 Mixing Dry Chemicals

- a. Using a 1 gallon (3.8 liter) bottle, fill the bottle 1/2 full with distilled or deionized water.
- b. Add 920 grams sodium acetate trihydrate crystals and mix until all the crystals are dissolved.
- c. Add 1800 grams or 1730 ml glacial acetic acid.
- d. Fill bottle to the top with distilled or deionized water and shake to thoroughly mix solution. Pour into the analyzer reagent bottle.
- e. The result is a buffer solution the same composition as the pre-mixed buffer.

3.4.3 Glycine Addition

- a. Add 1 liter of distilled or deionized water to a 1 gallon (3.8 liter) bottle.
- b. Add 350-400 grams of glycine crystals (glycine crystals, part number R-3513, is available from Capital Controls) to 1/4 full gallon bottle.
- c. Fill the 1 gallon (3.8 liter) bottle to the top with pH buffer solution (part number A-1806) and shake bottle to thoroughly mix. Make sure the glycine crystals are dissolved completely.
- d. Pour into the analyzer's reagent feed bottle.
- e. Set the DIP switch S3-4 (DIP package S3, switch number 4) to the ON position.

WARNING: Buffer solution contains glacial acetic acid, which is corrosive. Avoid contact with skin and eyes and breathing of vapor. Use rubber gloves when handling buffer solution, mixing with other reagents, or changing the reagent bottle. Use only with adequate ventilation (i.e. under a fume hood).

If solution comes into contact with skin or eyes, flush the affected area with water for 15 minutes. Get medical attention if burning sensation or irritation persists.

If solution is swallowed, call a physician immediately. **DO NOT** induce vomiting. Give large amounts of water containing milk of magnesia, followed with raw white of eggs beaten with water.

3.5 Conditioning the Analyzer

- 3.5.1 Hold filled reagent bottle upright and pull the tapered plug upward until the hole in the cap is plugged. Turn the bottle upside down and install into reagent feeder body. The weight of the reagent bottle opens the tapered plug and the bottle will rest on the O-ring on the top of the feeder body. Lift and turn the spring clip to secure the bottle.
- 3.5.2 Start the water sample flow of approximately 500 ml/minute (1 pint/minute). Water must be flowing over the overflow weir in the sample filter chamber to drain.
- 3.5.3 The sample must be supplied continuously for reliable operation. If the system requires occasional cutoff, provisions must be made to keep the electrodes wet.
- 3.5.4 Sampling from a pressurized source may require a pressure reducing valve to hold the flow constant. Maximum desired pressure is 5 psig (0.3 bar).
- 3.5.5 If sampling from wastewater, a flushing Y-strainer is necessary to prevent sample line pluggage. Other types of filter are not recommended.
- 3.5.6 Turn ON power to the analyzer.
- 3.5.7 If air bubbles are present in the reagent or flow tubing, squeeze, tap, or disconnect tubing at the analyzer and flush momentarily.
- 3.5.8 The analyzer requires a minimum stabilization time of 24 hours. During this time, reagents must be feeding into the cell. Normal reagent feed is approximately 3/4" to 1 1/8" level change in 24 hours.
- 3.5.9 After stabilization, calibration may begin. See Section 4.7.

4 SERVICE

4.1 Cleaning

Frequency of cleaning the analyzer is greatly affected by the condition of the water. By visually inspecting for dirt buildup, determine the need for cleaning. The following should be cleaned as indicated:

- 4.1.1 The inlet filter screen and overflow weir should be cleaned when a dirt buildup is observed or when the screen has been plugged sufficiently to stop flow. Refer to Figure 12, and lift out the overflow weir and filter screen. Hold parts under a water stream until clean and reinstall in the analyzer.
- 4.1.2 If the analyzer is clogged to the point where no water will pass over the overflow weir, the analyzer must be flushed. Observed below the motor or by the overflow tube directly behind the cell which drains into the block. See Figure 13 and flush as follows:
 - a. Turn the power switch to the OFF position.
 - b. Remove the flush plug in the flow tube with sample flowing, and allow to drain.
 - c. Install flush plug into the flow tube.
 - d. Repeat steps b and c as required.
 - e. Turn the power switch to the ON position and resume operation.

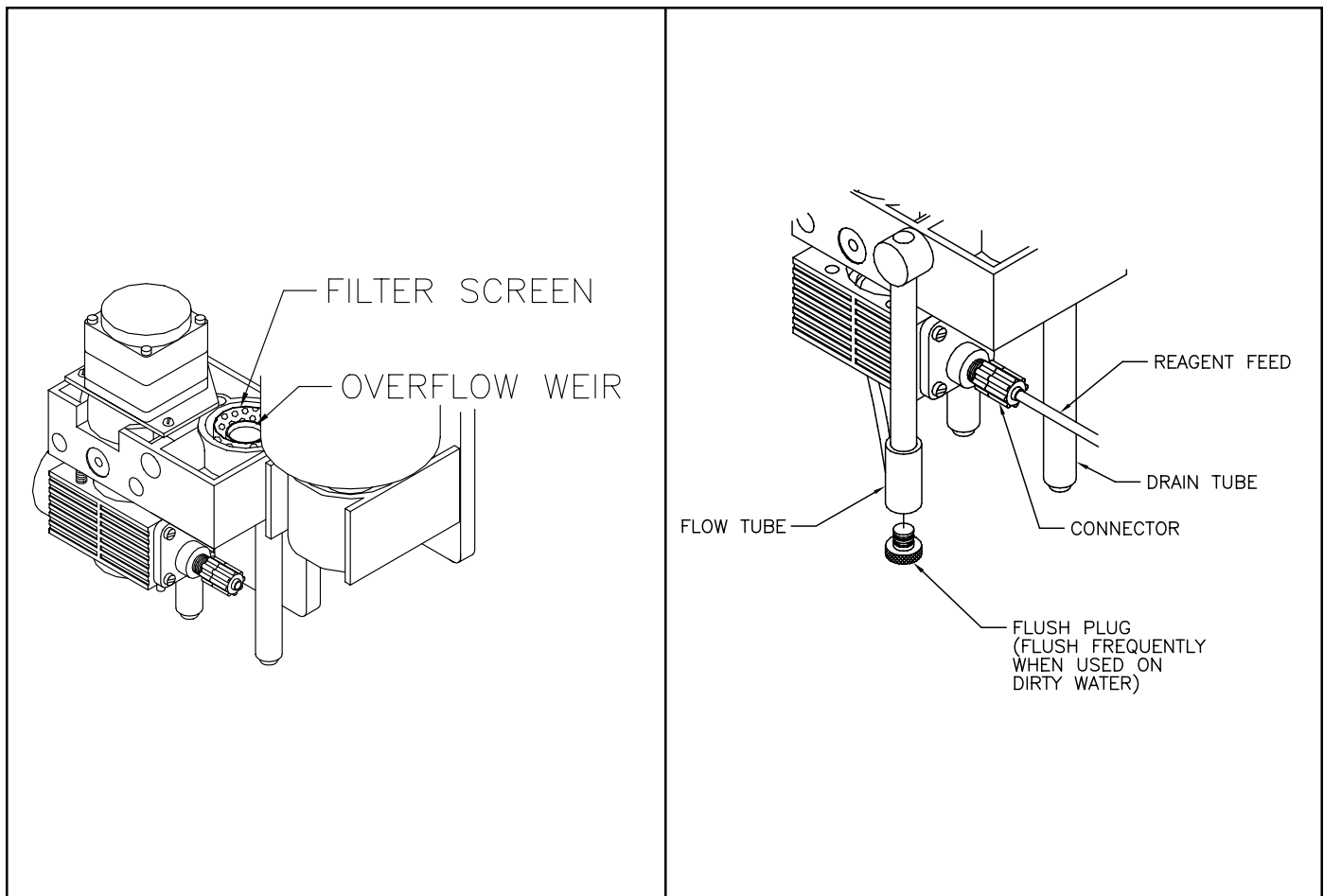


Figure 12 - Overflow Weir and Filter Screen

Figure 13 - Flushing the Analyzer

4.2 Reagent Valve

If the reagent feed has stopped and all air is removed from the tubing, the reagent valve must be cleaned. The feed rate of this valve is very small, therefore, be certain the reagent has stopped before cleaning is attempted. Check for feed by marking the reagent level on the bottle and observing the change in level over 8 hours. If the reagent level has not lowered during this period, the valve must be cleaned. Refer to Figures 14, 15, and 16 and proceed as follows:

- 4.2.1 Turn the power switch to the OFF position.
- 4.2.2 Stop sample flow.
- 4.2.3 Lift and rotate clip securing the reagent bottle. Raise reagent bottle approximately 2" and pull down on the valve stem until the hole in the cap is plugged. Remove reagent bottle.
- 4.2.4 Hold reagent bottle upright and remove cap. Place open bottle close to clear tubing connector at the adapter. Carefully unscrew connector nut releasing clear tube and drain remaining reagent into the reagent bottle. Screw cap on reagent bottle.
- 4.2.5 Remove flush plug to drain the unit. After the analyzer is completely drained, replace the plug.
- 4.2.6 Loosen the four (4) screws securing the adapter and remove the adapter and O-ring.
- 4.2.7 Clean out the bottom body if necessary.
- 4.2.8 The adapter provides mounting for the reagent valve components. This valve consists of a star wheel, bushing, pin, O-ring, spring and a screw. Loosen the screw and rotate the spring 180°. Pull up on the star wheel to release the pin from the bushing. Do NOT remove the bushing or O-ring.

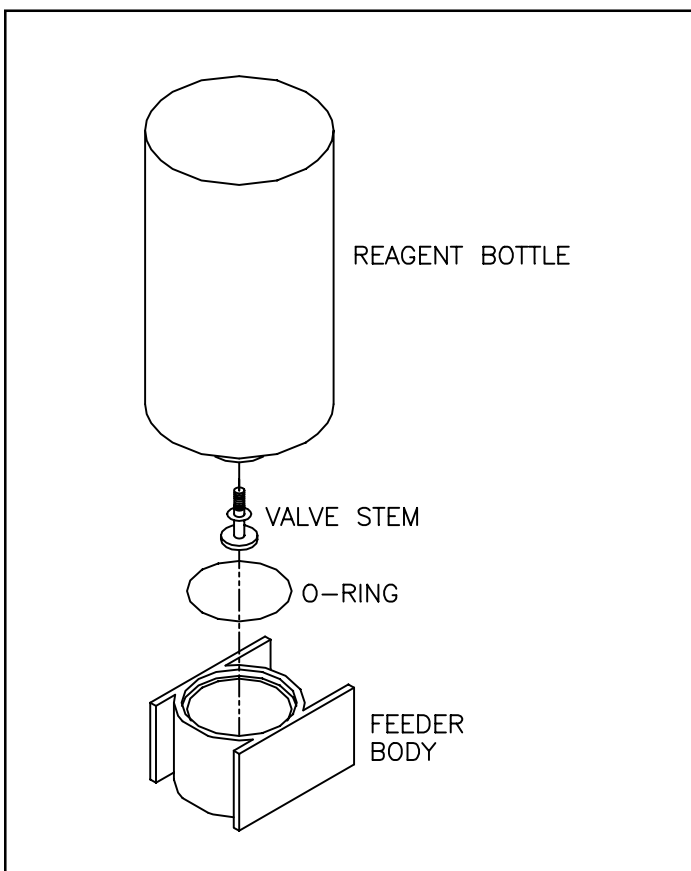


Figure 14 - Reagent Bottle Removal

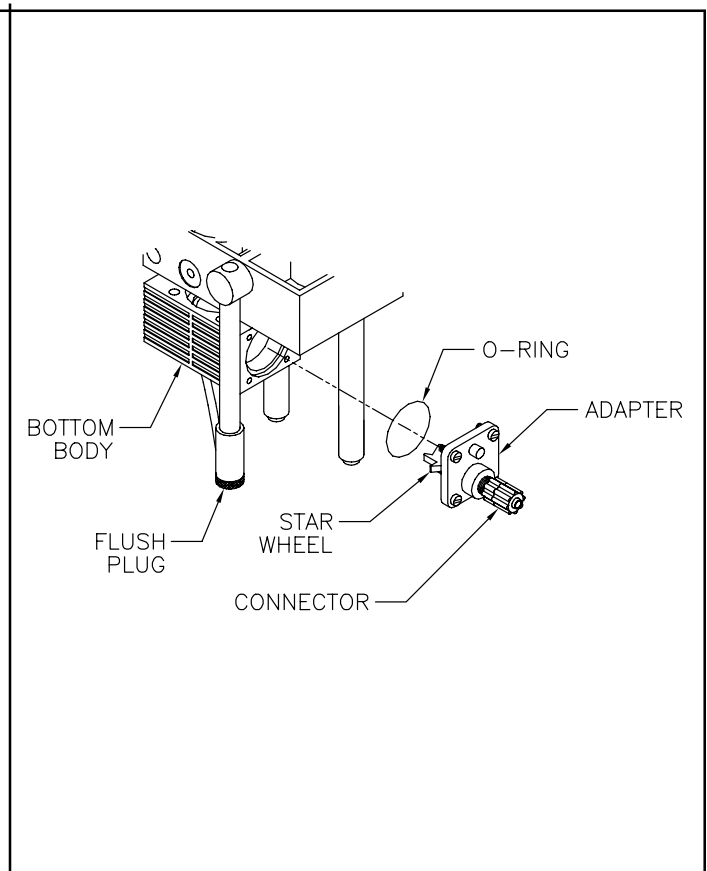


Figure 15 - Adapter Assembly

Clean parts under a water stream. If the 1/16" diameter holes in the star wheel are clogged, use a straight pin to remove the obstruction, being careful not to scratch mating surfaces or damage the edge of the hole. Place the star wheel and pin into the bushing. Turn the spring back 180° to apply force to the pin. Secure the screw.

- 4.2.9 Place the large O-ring into the groove and replace the adapter. Secure using the four (4) screws.
- 4.2.10 Reconnect clear tubing to connector, secure nut.
- 4.2.11 Invert the reagent bottle on the reservoir and secure with the clip.
- 4.2.12 Begin sample flow as described in Section 3
- 4.2.13 Turn the power switch to the ON position. If air bubbles appear in the clear reagent tubing, remove them as described in the Section 3.

4.3 Gold Electrode

Normal life of the gold electrode is three to five years. This can vary depending upon the chemical residual and the quality of the water. The gold electrode should appear clean and shiny.

NOTE: The gold electrode assembly contains 200 - 3/16" diameter PVC spheres within the top body of the analyzer. When this assembly is withdrawn, these spheres will drop out. Refer to Figures 17 and 18. Place a cup or other container under the assembly to catch the spheres.

- 4.3.1 Refer to the Service 4.2.1-4.2.7. Remove the adapter and all reagent.
- 4.3.2 Disconnect the wire from the gold electrode assembly.
- 4.3.3 While holding a container under the analyzer, unscrew the gold electrode by hand. As the assembly is withdrawn the spheres will begin dropping out. Hold a container below until all the spheres are removed. Remove the large O-ring on the electrode assembly.
- 4.3.4 Inspect the condition of the gold electrode. Clean and polish with water and a clean cloth. If the electrode is damaged, it must be replaced.

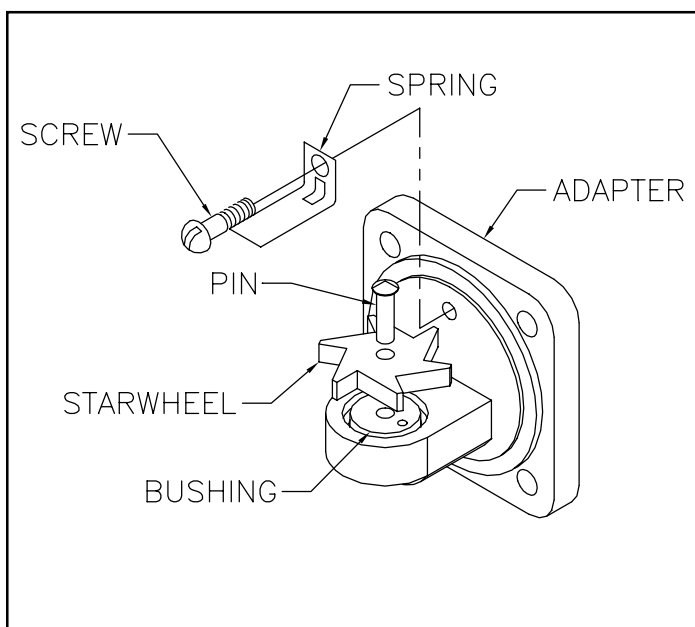


Figure 16 - Reagent Valve Components

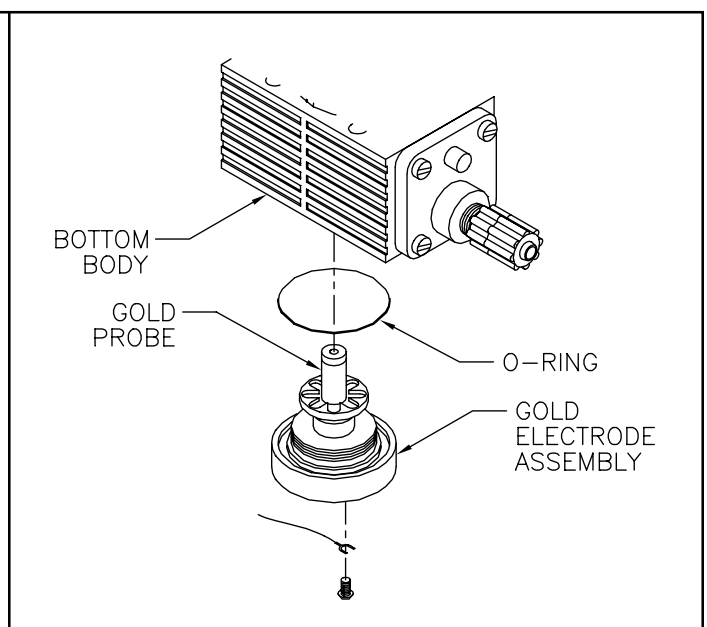


Figure 17 - Gold Electrode Assembly

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-
- 4.3.4 Place the large O-ring in the groove on the new electrode assembly and screw the assembly into the bottom body, by hand, until snug.
 - 4.3.5 Reconnect the wire to the gold electrode assembly.
 - 4.3.6 Remove the plug located in the analyzer top body. Deposit all spheres through the hole provided, and replace the plug.
 - 4.3.7 After depositing spheres, rotate the motor/striker assembly by hand, checking for rubbing, The striker can be observed below the motor. If the striker is not rotating, refer to Section 4.5. Turn the power switch to the ON position.

4.4 Copper Cell

NOTE: The copper cell contains 200 3/16" PVC spheres. When this assembly is removed, the spheres will fall. Place a cup or other container under the assembly to catch the spheres.

- 4.4.1 Turn the power switch to the OFF position.
- 4.4.2 Stop the sample flow to the analyzer.
- 4.4.3 Remove the drain plug and drain the water from the sediment trap.
- 4.4.4 Remove the gold electrode assembly. Refer to Service section 4.3.
- 4.4.5 Take care to catch the loose PVC spheres. Any buildup in the cell can be removed with a plastic scouring pad or similar mild abrasive.
- 4.4.6 After cleaning, reinstall the cell ensuring the cell gasket is in place.
- 4.4.7 Remove the plug located in the front of the analyzer's top body and deposit all PVC spheres through the hole. Replace the plug.
- 4.4.8 After depositing the spheres, rotate the motor/striker assembly, by hand, checking for smooth movement. If the striker is not rotating, refer to Section 4.5. Turn the power switch to the ON position.

4.5 Motor/Striker Assembly

Replacing the motor or striker assembly can be performed easily if the main analyzer is removed from the panel and taken to a table or flat surface.

- 4.5.1 Disconnect power to the analyzer motor. Remove motor wires from terminals M1, M2, M3 and G. See Figures 18 and 19.
- 4.5.2 Disconnect signal wires from copper and gold electrodes.
- 4.5.3 Remove reagent from the feeder body and reagent tubing from the valve adapter. Unscrew two 1/4" diameter screws holding the main assembly to the panel. Place the main assembly on the table.
- 4.5.4 With the main assembly upright, remove the three (3) screws holding the motor plate to the top body. Lift the motor straight up and out of the top body.
- 4.5.5 Invert analyzer assembly and empty the spheres into a container. Remove the valve adapter. The main assembly is now disassembled as far as required.

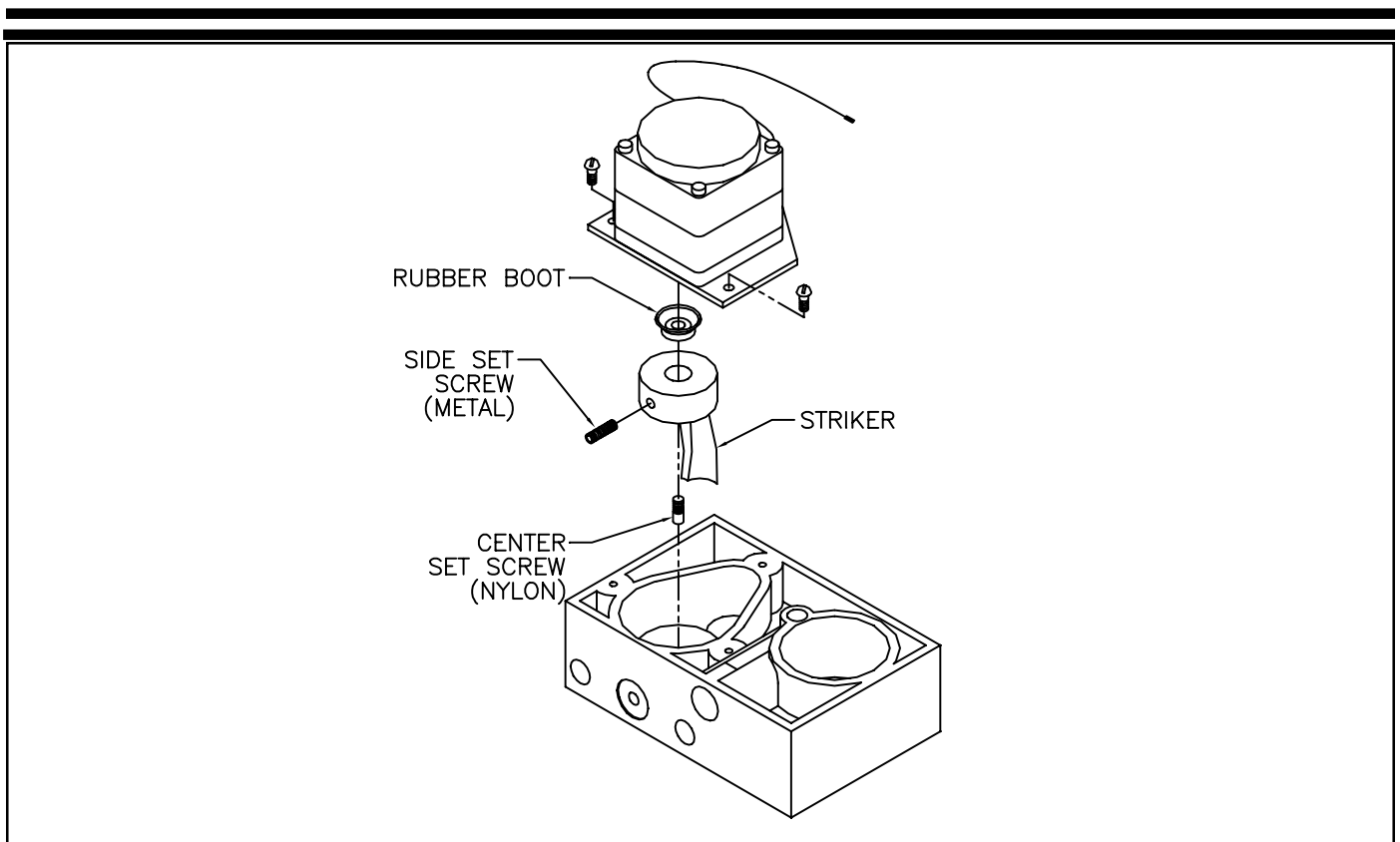


Figure 18 - Motor Striker Assembly

- 4.5.6. If the motor is to be replaced, remove the striker and rubber boot from the motor shaft. Install the boot on the new motor and striker after turning the center set screws out approximately two (2) turns. Refer to Figure 18.
- 4.5.7 Turn the side set screw in the striker until it contacts the motor shaft. The striker should slide onto the motor shaft when force is applied.
- 4.5.8 Fit the striker on to the motor so a 1/4" space is between the top of the striker and the motor plate. Insert the motor/striker assembly into the main analyzer assembly by pushing on the motor until the motor plate is seated on the top body.
- 4.5.9 Carefully remove the motor/striker from the main assembly. Lightly tighten the side set screw in the striker. Turn the center set screw until contact is made with the motor shaft, then back out the center set screw 1/8 to 1/4 turn. Loosen the side striker set screw and push up on the motor shaft. Re-tighten the side set screw snugly. Reinstall the motor/striker assembly with the three (3) motor screws.
- 4.5.10 Rotate the motor/striker assembly by hand checking for drag or rubbing.
- 4.5.11 Insert the 200 spheres and rotate motor/striker again, feeling for drag or rough spots. If drag is present, repeat steps 4.5.7 through 4.5.10 to adjust the striker.
- 4.5.12 Reassemble by reversing steps 4.5.1, 4.5.2, and 4.5.3.

4.6 Thermistor

Failure to the thermistor will appear as an excessively high or low signal. Proceed as follows for testing and replacement. Refer to Figure 18.

- 4.6.1 Turn the power switch to the OFF position.

4.6.2 Remove the two (2) thermistor wires from terminals T1 and T2, and remove the thermistor.

4.6.3 Connect an ohm meter to the thermistor wires. If the ohm meter shows a stable resistance reading between 2k and 4k, the thermistor is not defective. If the ohm meter shows zero ohms or goes into infinity, the thermistor is defective and must be replaced. Recalibration is required. See Calibration section 4.7.

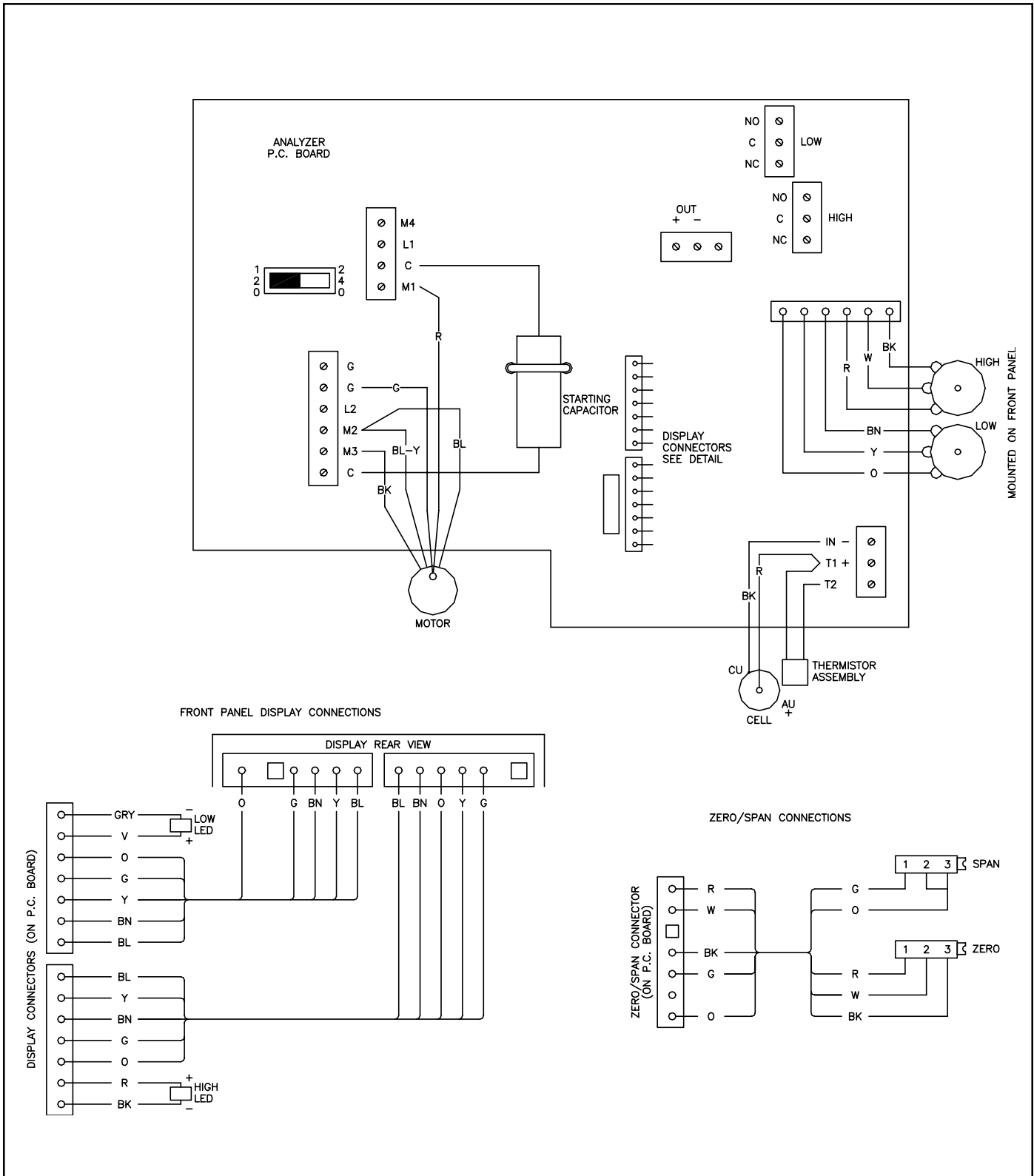


Figure 19 - Internal Wiring Diagram

4.7 Calibration

4.7.1 Chlorine Residual Analyzer

Instruments are calibrated at the factory and, at start-up require only Zero adjustment to compensate for the composition of the background water. Full electrical setup and adjustment should be done only after servicing, current output change, or if accuracy is suspect due to age or cell contamination. The analyzer provides accuracy to 0.002 mg/l for 0-2 mg/l range and below and 0.02 mg/l for 0-3, 0-5, 0-10 and 0-20 mg/l ranges. Ranges can be switched with the range selection DIP switches, without recalibration. The same calibration procedure is to be followed for measurement of any residual.

a. Zero and Span Calibration

Equipment required: small screwdriver

NOTE: Cross checking calibration should be performed with a amperometric titrator, particularly when measuring the residual of a water sample with high salt content, turbidity, etc. The DPD colorimetric method is subject to a number of interferences, and therefore, is not reliable for checking calibration.

Set the analyzer for the desired range using the DIP switches per Table I, in the Start-up section, and place the correct range label on the front panel.

1. With the power ON, run sample water through the analyzer cell for 24 hours to condition the cell.
2. After cell conditioning, run untreated (zero residual) water through the analyzer cell. Allow one (1) hour for stabilization.
3. Adjust the ZERO control until the digital display reads 000 mg/l.
4. Run a treated water sample of known residual value through the analyzer and allow one (1) hour for full stabilization.
5. Adjust the SPAN control until the digital display reads the value of the known sample.

b. Coarse Zero Adjustment

NOTE: If unable to adjust the front panel ZERO control low enough, or if too sensitive causing large shifts in the reading, a coarse zero adjustment (CZ) is provided on the internal printed circuit board.

1. With the power ON, run untreated water (zero residual) through the analyzer cell. Allow one (1) hour for stabilization.
2. Turn the front panel ZERO control full counterclockwise.
3. Adjust the internal CZ control until a small negative number is read on the display.
4. Adjust the front panel ZERO control until the digital display reads 000 mg/l.
5. Proceed with the SPAN control adjustment previously described in 4.7.1.a.4 and 4.7.1.a.5.

c. Coarse Span Adjustment

If there is insufficient front panel SPAN adjustment, an internal coarse SPAN adjustment (S) has been provided.

For residuals other than chlorine, switch S3-4 has been provided. Setting S3-4 ON will double the cell output to allow the weaker residuals to be measured.

d. Response Speed

For the best stability, especially at the lowest range (1 mg/l and below), switch S4-1 should be ON. For slightly faster response, and for troubleshooting with simulated inputs, switch S4-1 should be OFF.

e. Output Signal Adjustment

Equipment required: small screwdriver and calibrated recorder on output

NOTE: The bare wire jumper marked W1 on the printed circuit board determines the current output range. If the W1 jumper is in, the range is 0-20 mAdc or 0-50 mVdc. If the W1 is out, the range is 4-20 mAdc. The 0-50 mVdc range also has a 2.5 ohm resistor connected across the + and - OUT terminals. See Figure 20.

The Z2 and S2 controls on the internal printed circuit board require adjustment only if the W1 jumper is being changed or if the board has been replaced.

1. Set the ZERO control as described in 4.7.1 a.1-3.
2. Adjust Z2 control until the recorder reads 0 mg/l.
3. Set the SPAN control as described in 4.7.1.a.4-5.
4. Set S2 control until recorder matches the display.

f. Alarm Set-up and Adjustment

Equipment required: small screwdriver, 100K ohm 1/4 watt resistor, line cord

Alarm set-up and adjustment is required only if the internal printed circuit board or alarm potentiometers have been replaced. Adjustment is best done on a test bench before the board is installed and without connecting to the electrodes, thermistor or motor.

1. If necessary, loosen the set screws on the front panel ALARM knobs and reposition the indicator for equal over-travel at both ends of the alarm settings. Re-tighten screws.
2. With the power switch OFF, and the line power disconnected, connect the line cord to L1 and L2 terminals. Connect the ground to the G terminal.
3. Connect the front panel to the printed circuit board per Figure 20.
4. Connect the 100 K ohm resistor to the + IN terminal and to the J3-2 receptacle.
5. Set instrument to the 0-20 mg/l range using the DIP switches per Table I. Set S4-1 switch to OFF.

6. Plug in line cord and turn the power switch ON.
7. Adjust the SPAN and/or ZERO controls to obtain a reading of 18.00 mg/l on the digital display.
8. Set the HIGH alarm to 90%.
9. Turn ALARM potentiometer on the printed circuit board full counterclockwise. Then turn clockwise until the HIGH lamp on the front panel just lights.
10. Verify the LOW alarm by setting the LOW alarm knob to 100%, then slowly decrease until the LOW lamp on the front panel just goes out. The LOW alarm setting should be 85-95%.

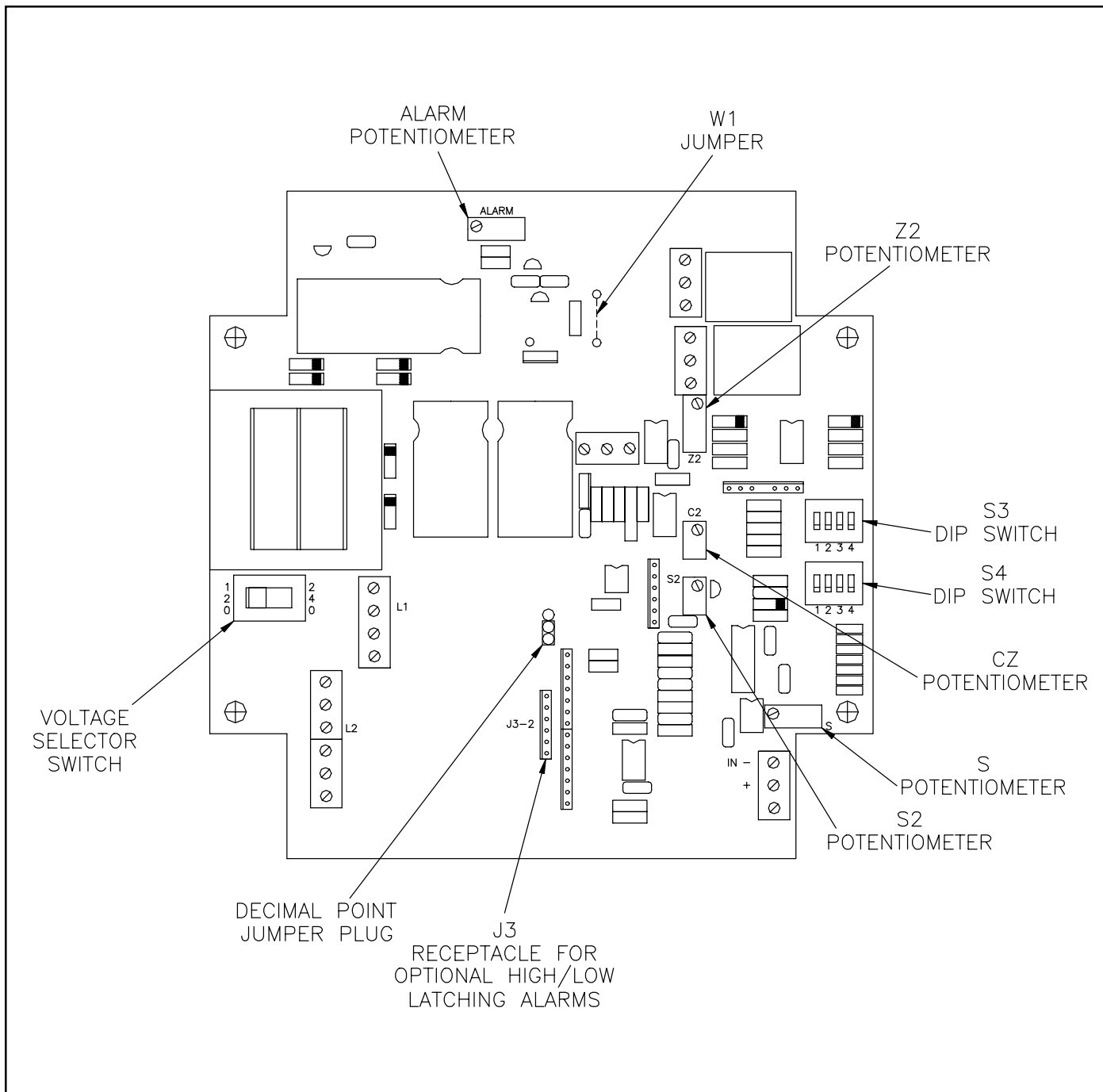


Figure 20 - Printed Circuit Board

4.8 Motor

Power to the motor is through a capacitor. Should the capacitor fail, the motor will stop or become very weak. Test and replace the capacitor, as follows.

CAUTION: Work on this portion of the instrument will cause exposure to line voltage. To prevent shock, proceed with caution.

4.8.1 Motor Capacitor Test - Figure 18

- a. Using an AC Voltmeter, measure and note the line voltage across terminals L1 and L2.
- b. Using an AC Voltmeter, measure and note the voltage across the capacitor terminals marked C.
- c. Voltage across the capacitor should be at least 1 times greater than the applied voltage at terminals L1 and L2.

4.8.2 Motor Capacitor Replacement

- a. Disconnect the line voltage.
- b. Remove the two (2) capacitor wires from terminals C.
- c. Remove the capacitor from its mounting bracket.
- d. Remove the insulation from the faulty capacitor and place on the new capacitor.
- e. Replace the faulty capacitor by connecting the capacitor wires to terminals C.
- f. Secure the new capacitor to the printed circuit board with a cable tie.
- g. Test the analyzer for proper motor operation. If, after testing and replacing the capacitor, the motor still does not operate, the motor is probably at fault. Replace motor as described in Service section 4.5.

4.9 Recommended Preventive Maintenance

4.9.1 Weekly

- a. Remove and clean the overflow weir and the filter screen. Refer to Figure 12.
- b. Clean the cavity where the overflow weir and filter screen reside. Reinstall the overflow weir and filter screen. Ensure that the end of the sample tubing is between the inside edge of the screen and the overflow weir.
- c. Remove the flush plug (Figure 13) for 5 seconds to dislodge any sediment that has collected in the flow tube. Reinstall the flush plug. If difficult to install, apply a light film of fluorolube grease (part number BM-1084) to the O-rings.
- d. Remove the buffer reagent feed bottle (if supplied) as shown in Figure 14. Clean any excess of splashed reagent off the feeder body and O-ring. Ensure the valve stem is sealing against the reagent bottle cap to prevent buffer spillage.
- e. Fill the reagent bottle 50% with either premixed pH 4 buffer solution (part number A-1806), for free chlorine measurement. For total chlorine measurement, dissolve the appropriate amount of potassium iodide (KI) crystals (part number R-410) into the buffer solution. Fill the bottle with distilled or deionized water (do not use city or tap water). Ensure all air is removed from the tubing between the feeder body and the starwheel assembly for proper buffer feed.

4.9.2 Monthly

- a. Check calibration of the analyzer by titrating the incoming sample (from the sample tubing at the overflow weir and filter screen) and noting the residual reading at the time of the sample removal.
- b. If the reading on the analyzer does not match the titrated sample, perform a zero and span calibration.
- c. Clean and flush the buffer feeder bottle of any white reagent crystalline formation.

4.9.3 Yearly

- a. Depending upon the incoming sample conditions, disassemble the analyzer by turning off the incoming sample, removing power to the analyzer and removing the gold probe and copper cell.
- b. The gold probe and copper cell may be cleaned with a nonmetallic scouring pad similar to 3M Scotch-Brite[®].
- c. Replace PVC cleaning spheres.
- d. After cleaning, condition the analyzer by allowing it to run on chlorinated water for 24 hours.
- e. Perform a zero and span calibration.
- f. Replace copper cell if worn or grooved and cell gaskets.

4.10 Purging Circuit (Optional) Figure 21

The Capital Controls patented purging circuit is designed to reduce or eliminate effects of plating on the electrodes in cases of high conductivity (>900 mS/cm) or high sulfides by periodically reversing the cell current to deplate most contaminants.

The purging circuit can also be used to enhance lower residual monitoring (<1.0 mg/l) and higher residual monitoring when operating in the 0-5 ppm range. An existing Model 1870E analyzer can be modified to include the purging circuit by purchasing part number BM-5189 (for use on ranges up to 0-3.0 mg/l), or BM-5189-1 (for use on range 0-5 mg/l only).

- 4.10.1 **Remove and discard the RED and BLACK leads from the analyzer (+) and (-) IN terminals to the cell.**
- 4.10.1 **Adjust the analyzer ZERO control until the analyzer display reads 000.**
- 4.10.3 **Connect the RED and BLACK leads provided with the Purging Circuit between (+) and (-) IN terminals and the cell (RED from gold or center electrode to +IN, BLACK from copper electrode to -IN).**
- 4.10.4 **Connect the RED and BLACK leads provided with the Purging Circuit between (+) and (-) OUT terminals to (+) and (-) IN terminals on the analyzer (RED from +OUT to +IN, BLACK from -OUT to -IN).**
- 4.10.5 **Set line voltage switch as required. Cut and remove the plastic strip on the switch for 120 Vac power. Connect power.**

4.10.6 Calibrate the SPAN adjustment. Refer to Start-up section. ZERO calibration is not necessary unless an accuracy greater than ± 0.01 ppm is required.

4.10.7 When measuring chlorine residual, the bias voltage must be (-) 0.300 volts (± 0.01) as measured between the (-)OUT and (-)IN terminals on the Purging Circuit. The negative lead of the voltmeter must be connected to the (-)OUT terminal and the positive lead to the (-)IN terminal. The bias voltage is present only during the period of time that light A1 (upper RED LED) is on. The bias voltage is set at the factory and is only to be adjusted after consulting with the factory.

4.10.8 The timing of the three lights (A1, B and A2) is critical and very difficult to set in the field.

Light A1 [← ON → | ← OFF →]

16 sec 4 sec.

Light B [← ON →]

3.2 sec.

Light A2 [← ON →]

1.5 sec.

Note: This timing is factory set.

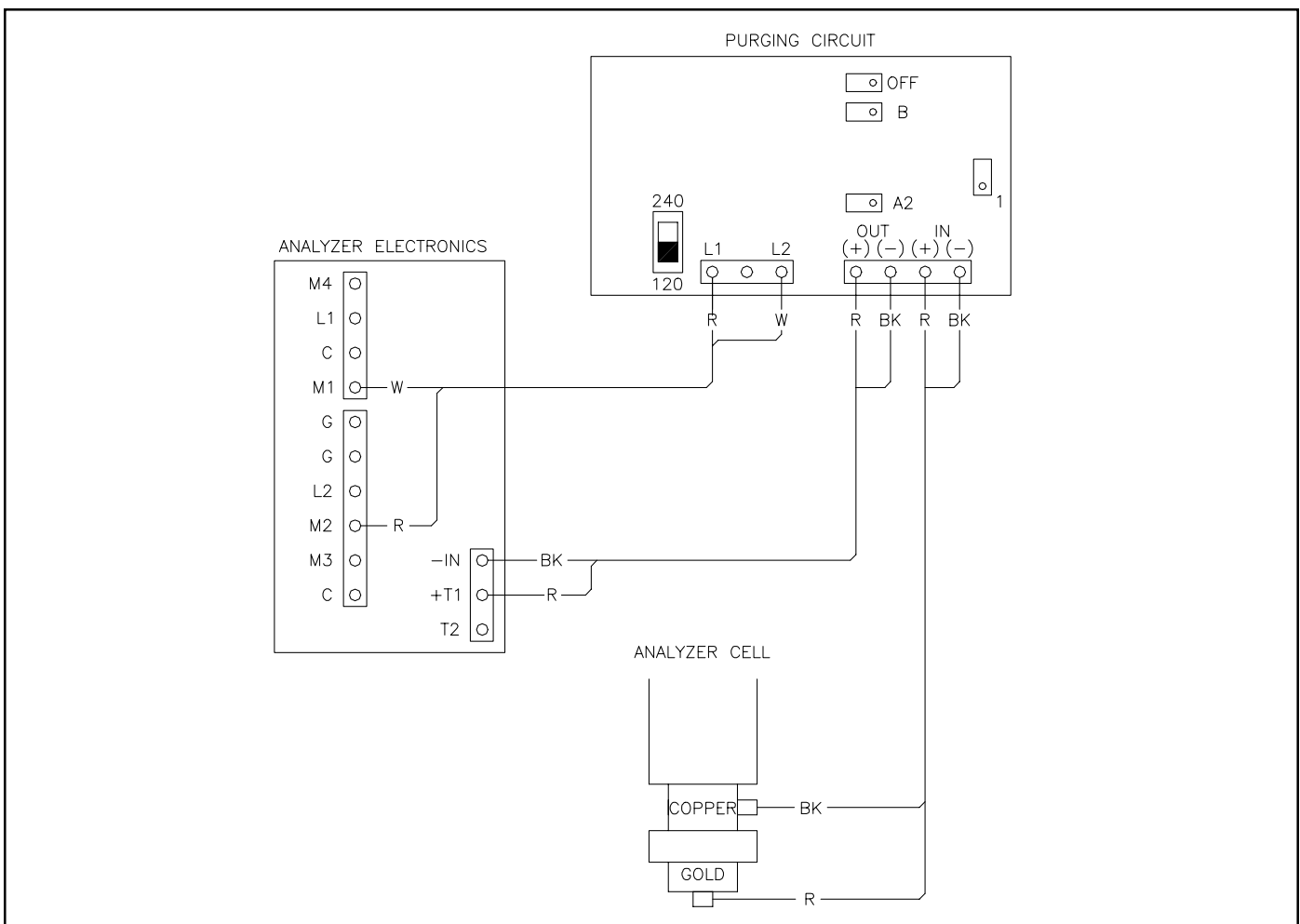


Figure 21 - Purging Circuit

5 ACCESSORIES AND RECOMMENDED SPARE PARTS

See Figure 6 for additional plumbing accessories

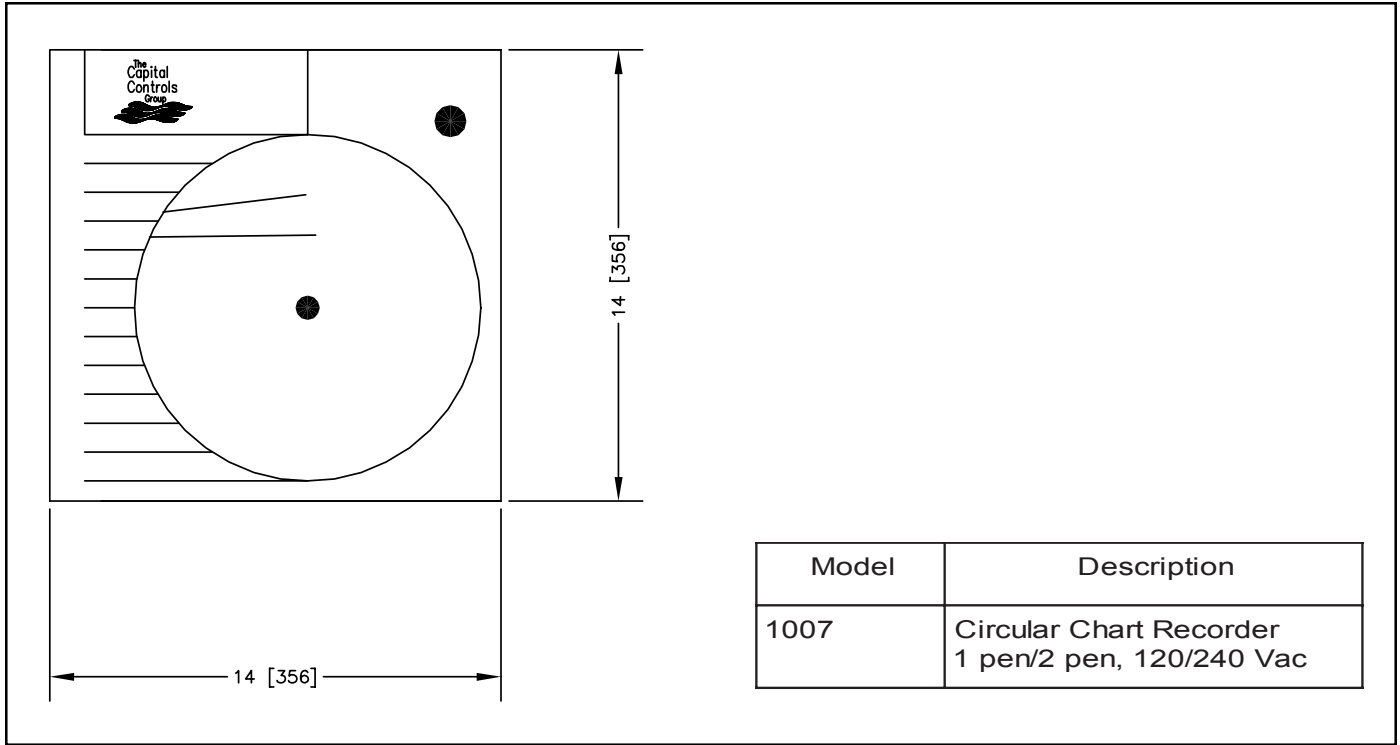


Figure 22 - Recorder

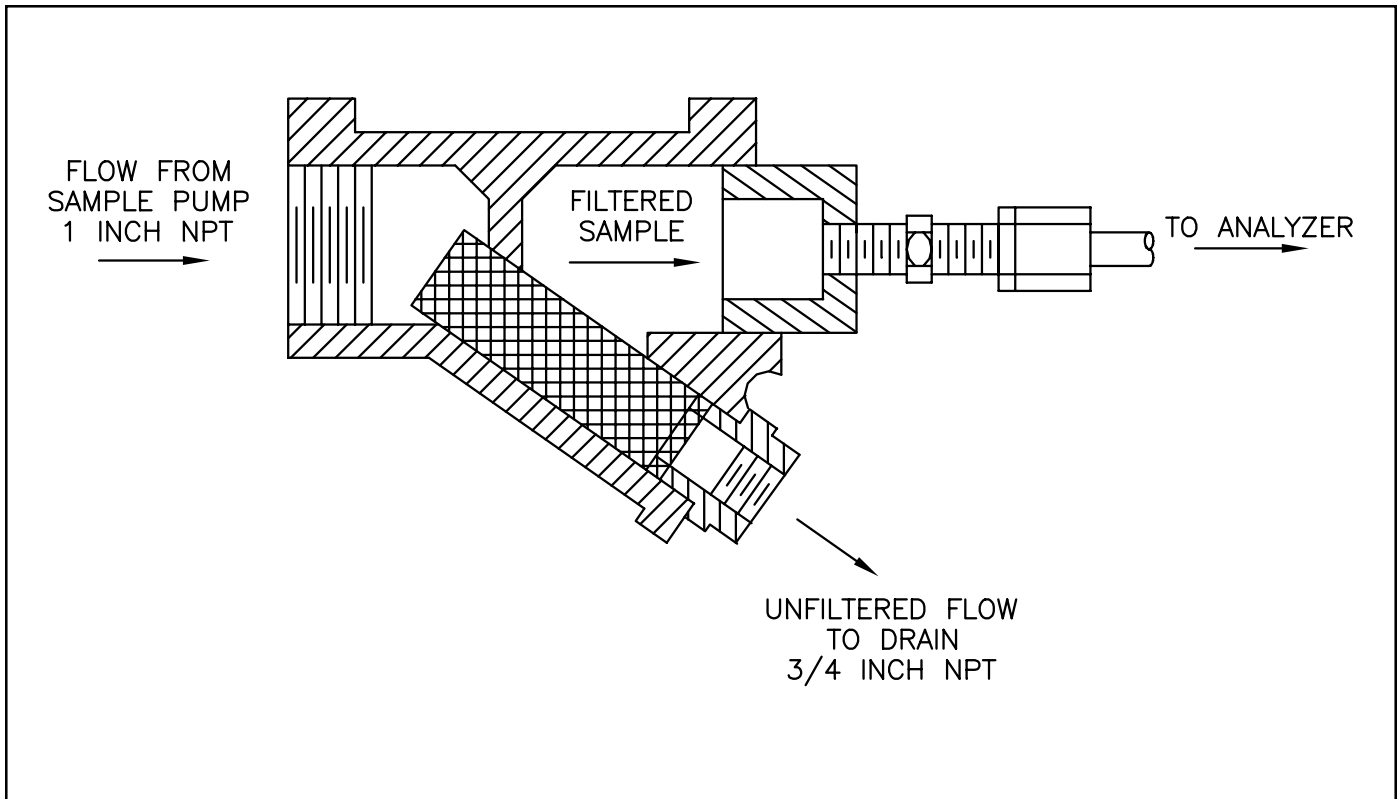


Figure 23 - Analyzer With Flushing Y-Strainer



6 TROUBLESHOOTING CHART

NOTES:

1. Verify sample flow at the analyzer intake between the overflow weir and the filter screen (500 ml/minute [1 pint/minute]) at 5 psig. Verify constant sample flow through the analyzer by observing flow at the drains **SAMPLE MUST ALWAYS FLOW TO THE ANALYZER.**
2. Verify analyzer motor is connected to the proper power supply and operating.
3. Verify reagent feed to the analyzer. Let the analyzer run for 24 hours and measure reagent usage (normal 3/4" to 1 1/8" [20 to 30 mm] change in level).

Trouble	Probable Cause	Corrective Action
1.Excessive high or low output signal	a.Air bound sample or reagent line. b.Dirty or worn electrode c.Damaged thermistor. d.Faulty printed circuit board.	a.Check drain tubing for sample flow. For inadequate flow from left drain, tap base of flow tubing to release trapped air bubbles. b.See Service section III. Section 4.5 c.Test and replace thermistor. Section 4.5 d.Replace printed circuit board. Section 4.6
2.Output reacts slowly to residual change.	a.Coating on measuring cell. b.Excessive suspended solids. c.Non-representative sample.	a.Clean electrodes b.Filter sample. c.Relocate sample point.
3.Motor operation noisy, erratic, no motion.	a.Faulty capacitor. b.Motor wired incorrectly. c.Misaligned strider has PVC spheres jammed. d.Faulty motor.	a.Replace capacitor. See Section 4.7 b.Rewire per label diagram. See Figure 13. c.Adjust striker assembly. See Service Section IV. Check plug is tight in top body. d.Replace motor. See Section 4.7
4.Inadequate span adjustment	a.Coating on measuring cell b.Solids in measuring cell. c.Improper range selection.	a.Clean electrode. See Section 4.3, Calibration. b.Filter sample. c.Set range per Table I in Start-up section 3.
5.Inability to zero.	a.Residual present sample	a.See Section 4.7
6.Improper reagent feed.	a.Faulty star wheel.	a.See Section 4.2
7.Excessive reagent feed.	a.Striker motor rotation reversed. b.At shutdown, star wheel aligned for constant reagent feed. c.Worn or cracked star wheel.	a.Motor must turn counterclockwise (top view). Inspect motor leads for proper connection. See Figure 13. b.Jog motor to reposition star wheel. c.Replace star wheel.
8.Insufficient reagent feed.	a.Star wheel plugged. b.Blockage in line to star wheel.	a.Clean. See Section 4.2. b.Check per Section 4.2.
9.Display blank.	a.Power Off. b.Bad connector or incorrect wiring to display. c.Faulty display.	a.Turn power switch ON or connect power. b.Check for proper plug connection or repair or replace cable assembly. See Figure 13. c.Replace display.
10.Display range is always off by a factor of 10.	a.Decimal point jumper in the wrong position.	a.Change position of the jumper plug. Refer to Table I in the Section 3.

EC DECLARATION OF CONFORMITY

This is to certify that the

1870E Residual Analyzer

Manufactured by
Capital Controls Company, Inc.
3000 Advance Lane
Colmar, Pennsylvania 18915
Tel 215-997-4000

Conforms with the protection requirements of European Council Directive 89/336/EEC as amended by 91/263/EEC and 92/31/EEC, relating to Electromagnetic Compatibility and European Low Voltage Directive 93/68 EEC, relating to Electrical Equipment Safety, by the application of:

Test results to the following EMC standards:

EN50081-1 Emission Standard
(BSEN 55022 Class B)


EN50082-1 Generic Immunity Standard

Standards applied for LVD:

BSEN 61010-1 Safety Requirements for
Electrical Equipment for Measurement, Control and Laboratory Use

Tests carried out by Capital Controls Company, Inc., dated June through December 1996, Met Laboratories, Baltimore, Maryland, dated December 1996 and Access Test Services Ltd, Chesnut Hill, Keswick, UK date September 1997.

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Signed: 
Wayne B. Huebner
General Manager
Capital Controls Co., Inc.

Date: January 8, 2000



Design improvements may be made without notice.

Represented by:



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