

Foxcroft Equipment & Service, Co. Inc.

Model FX-1000p-B

Bufferless Amperometric Chlorine Residual Analyzer

Instruction Manual



Warning!
Please Read Carefully and Save.

The FX-1000p-B Bufferless Amperometric Chlorine Analyzer includes an instruction manual that contains important information about its operation. Purchasers who install this analyzer for use by others must leave this instruction manual or a copy with the user.

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IMPORTANT SAFETY INFORMATION

Please read and observe the following:

Opening the analyzer door exposes you to line voltage, if present, at power terminals TB-1D at the bottom of the enclosure. This may be hazardous. Always remove power source before entering this area of the enclosure. However, the display board contains only low voltage and is completely safe to handle.

Wiring or repairs should only be performed by qualified personnel and only to an unpowered analyzer.

Whenever it appears that system safety is questionable, disable the system to ensure against any unintended operation. For example, an unsafe condition is likely when:

1. The system appears visibly damaged.
2. The system fails to operate properly or provide the intended measurements.
3. The system has been stored for long periods at temperatures above 120°F (49°C).

This measurement system must be installed by specially trained personnel in accordance with relevant local codes and instructions contained in this instruction manual. Observe all technical specifications of the system. If one line of the power source is neutral, use a double-pole main switch to disconnect the analyzer.

HELPFUL IDENTIFIERS

In addition to information on installation and operation, this instruction manual may contain WARNINGS pertaining to user safety, CAUTIONS regarding possible instrument malfunction, and NOTES on important, useful operating guidelines.

WARNING: A warning looks like this. It warns you of the potential for personal injury

CAUTION: A caution looks like this. It alerts you to the possibility of instrument malfunction or damage.

NOTE: A note looks like this. It alerts you to important operating information.

Introduction

General Information

Instrument Description and Capability

The FX-1000p-B Bufferless Amperometric Chlorine Residual Analyzer amperometrically measures the free chlorine in treated fresh or drinking water applications **ONLY**.

The system provides a 4-20mA analog output that is scaled to the factory set measuring range. The system can be re-ranged in the field to any of its other measuring ranges. This output can be used to drive a residual chlorine control system using compound-loop or set point controllers; or input to a chart recorder, telephone dialer, or a SCADA system.

Three important factors enable the FX-1000p-B to provide drift-free measurements:

1. Flow rate to sample flow cell is kept constant.
2. Large surface area made with pure grades of gold and copper are used to measure the residual chlorine.
3. The sample flow cell has a reliable cleaning method to keep the electrodes free of dirt, ensuring measurement accuracy. The distilled white vinegar buffer solution, mixing balls, and process chlorine act together to keep the flow cell clean.

Component Identification

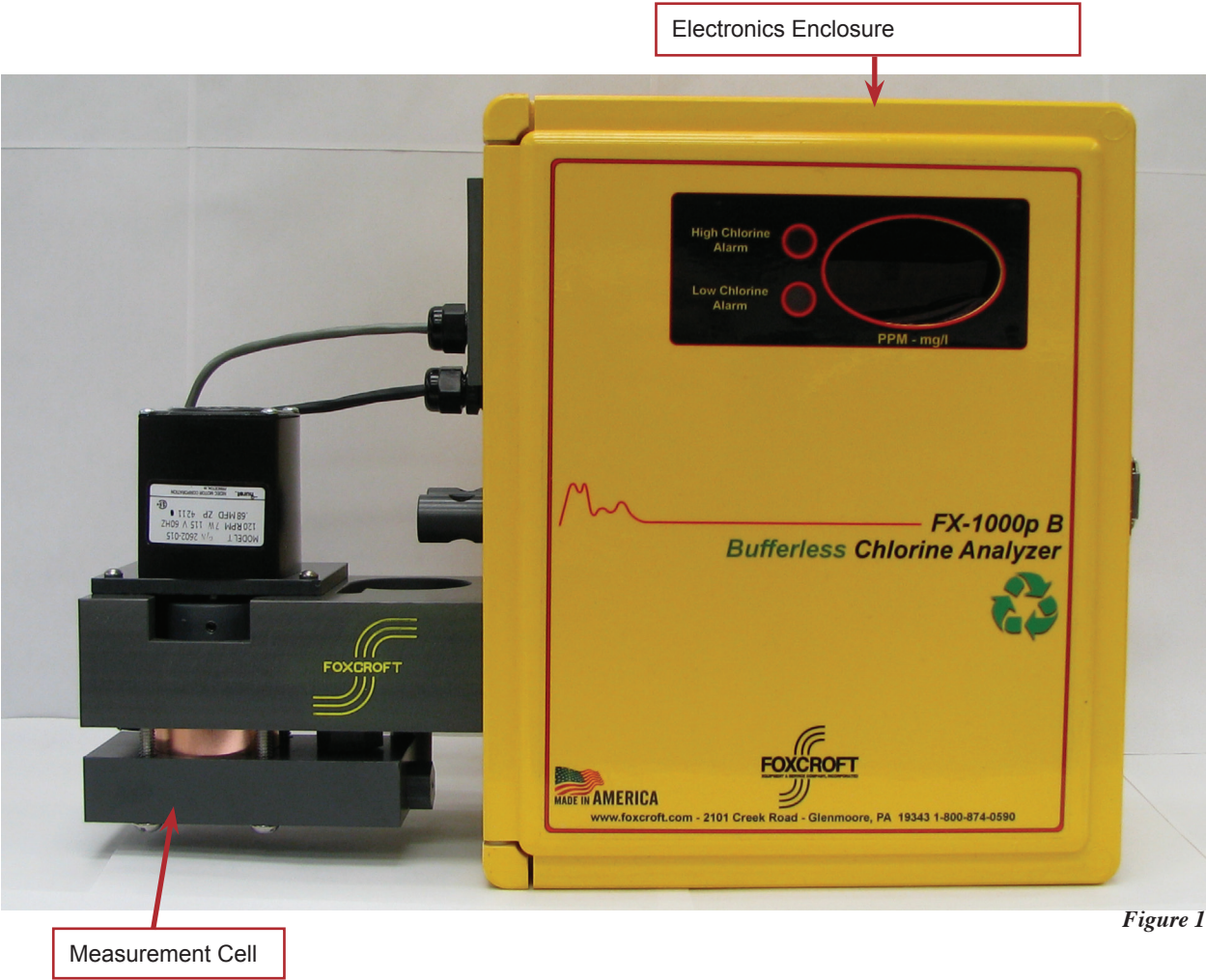


Figure 1

Mounting Dimensions

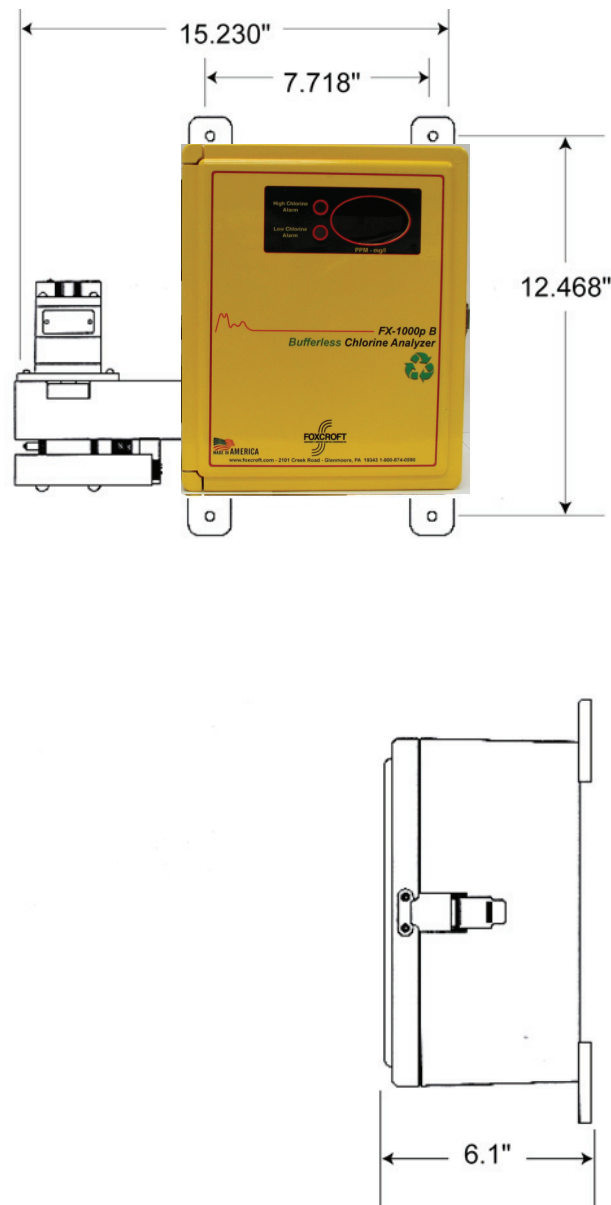


Figure 2

Specifications

Operational

Type of Measurement	Amperometric (free)
Measurement Range	0-5.00 ppm (mg/l) factory-set range; other field-configurable measuring ranges are: 0-0.50; 0-1.00; 0-2.00; 0-3.00; 0-10.0; 0-20.0; 0-0.50; and 0-60.0 ppm (mg/l)
Display	Three-digit LED; 0.56 in. (14 mm) high
Ambient Conditions	34-120°F (0-49°C); 0-95% relative humidity, non-condensing
Analog Output	One isolated 4-20mA (600 ohms max. load)
Relays	Two electromechanical relays (high and low alarms); SPDT (form C) contacts; rated 1A @ 120 VAC
Power Requirements	100-130 VAC, 50/60 Hz. (30 watts); optional 200-240 VAC, 50/60 Hz.

Performance

Sensitivity	0.001 ppm (mg/l)
Accuracy	+/- 2.0% of full scale
Repeatability	0.01 ppm (mg/l) or 1% of full scale, whichever is greater
Stability	+/- 1% of full scale per month
Response Time	4 seconds from sample entry to display indication
Full Scale Response	1.5 to 2.0 minutes

Sampling

Sample Temperature Range	34-120°F (0-49°C)
Sample Flow Rate	250-1000ml/min. (500 ml/min. recommended)
Sample Cell Use	120 ml/min fixed
Sample Supply	Continuous. Where sample flow is interrupted, provisions must be made to keep the electrodes wet.
Sample pH Range	4.0-7.5 pH - must not vary > +/- 0.05
Sample Alkalinity Range	<125 ppm (mg/l) total
Sample Turbidity Limit	Less than 250 NTU
Electrode Materials	Cathode (measuring): Gold (24K, 99.95%) Anode (reference): Copper (99.9%)
Sample Limitations	Samples containing high concentrations of metal ions or certain corrosion inhibitors may affect analyzer operation.

Mechanical

Enclosure	NEMA 4X; fiberglass; surface mount
System Net Weight	14.8 lbs. (6.7 kg) approximately
Sample Inlet Line	1/4" id x 3/8" od x 3' length, clear flexible PVC tubing
Drain Lines	5/8" id x 3/4" od x 3' length, clear flexible PVC tubing (2)

1 Installation

1.1 Unpacking

After unpacking, it is recommended to save the shipping carton and packing materials if the instrument must be stored or re-shipped. Inspect the equipment and packing materials for signs of shipping damage. If there is any evidence of damage, notify the transit carrier immediately.

The shipping container contains the following:

- 1 FX-1000p-B Bufferless Amperometric Chlorine Analyzer
- 1 Sample Tubing 1/4" id x 3/8" od x 3' length, clear flexible PVC tubing
- 1 Sample Drain Hose 5/8" id x 3/4" od x 3' length, clear flexible PVC tubing
- 1 Overflow Drain Hose 5/8" id x 3/4" od x 3' length, clear flexible PVC tubing
- 1 Set of Four Mounting Feet with Four Screws
- 1 Instruction Manual

Serial Number

The FX-1000p-B Bufferless Amperometric Chlorine Analyzer measurement system has two serial number labels found on the bottom right side of the enclosure, and on the top of the base plate inside the enclosure. The label on the outside of the enclosure indicates the chlorine residual range. Should technical assistance be required, refer to the serial number to identify your system.

1.2 Mechanical Requirements

Location

Mount the FX-1000p-B Bufferless Amperometric Chlorine Analyzer in a location that is:

- Out of direct sunlight
- Protected from the elements (rain, snow, ice, dust, etc.)
- As close to the sample point as possible to minimize sample lag time
- Accessible
- Clean and dry where there is little or no vibration
- Protected from corrosive fluids
- Within ambient temperature limits (34-120°F, 0-49°C)

Important: *Mounting the system in direct sunlight may increase the ambient temperature above the maximum specified limit.*

Mounting

1. Attach the four mounting feet to the rear of the electronics enclosure using the included flat head screws.
2. Orient the analyzer so that the sample flow cell drain outlets are pointing downward.
3. Anchor securely to a wall at approximate shoulder height for convenience.

The FX-1000p-B should be level from side to side and front to back to ensure that its integral weir operates properly.

1.3 Sample Point Selection Guidelines

The sample must be taken at a point after the chlorine has been thoroughly mixed and has had time to react completely with the process water. The sample line should be run with 3/8" diameter tubing to minimize lag time between the process water and analyzer.

The sample point should always be located as close to the analyzer as possible so that the residual chlorine in the water sample at that point is essentially the same as that in the analyzer flow cell.

A sample point that is too close to the chlorine injection will deliver a sample that is not mixed adequately or has not had sufficient time to complete the chemical reaction, thereby producing inaccurate readings.

1.4 Sample Line

When installing the sample line into the larger process pipe, use corrosion resistant brass or plastic fittings only. The sample tap should be installed into the center of the pipe from either the top or side to minimize chance of introducing air bubbles or sediment into the analyzer.

A sample valve upstream of the sample flow cell inlet tubing is required. We suggest using a metering ball valve, needle valve or globe valve. If pressure exceeds 15 PSI, a pressure reducing valve is required.

1.5 Sample Flow

Ensure that the water sample line is capable of delivering a continuous flow between 250 and 1000 ml per minute to the sample valve at approximately 15 psi. If pressure exceeds 50 psi, use an auxiliary water pressure reducing valve. If necessary, due to a long tubing run, increase the flow to the sample flow cell to reduce the water sample transport time.

Consistent flow is critical to accurate measurement. A change in flow rate during operation of a calibrated analyzer will require a recalibration of the analyzer. It is preferred to install a pressure regulator and flow control valve to ensure a consistent flow. The part number FX-1000p-RM is available to control the sample flow and pressure into the analyzer.

Dirty water applications require a flushing wye strainer to remove particulates from the sample.

Installation (Plumbing)

1.6 Plumbing Connection To The Analyzer

Connect the supplied 1/4" id x 3/8" od x 3' length, clear flexible PVC sample line to the flow control valve and secure. Cut if necessary to keep the sample line as short as possible. Route the tubing down to the analyzer, through the sample line guide hole and into the flow cell. Insert the end of the tube about half way down from the top edge of the center drain cup in the flow cell.

Connect the two supplied 5/8" id x 3/4" od x 3' length, clear flexible PVC drain lines to the overflow drain on the right side of the flow cell block and to the measuring cell drain on the left side. Route the hoses down to maintain gravity feed into a drain.

Typical Plumbing



Figure 3

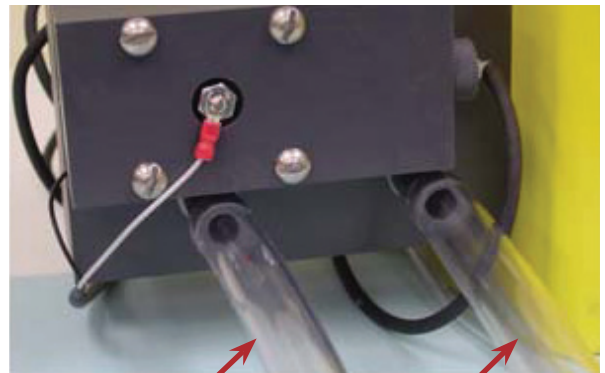


Figure 4

Sample Drain

Overflow Drain

1.6.1 Plumbing Diagrams for Various Applications

Clean Water Application

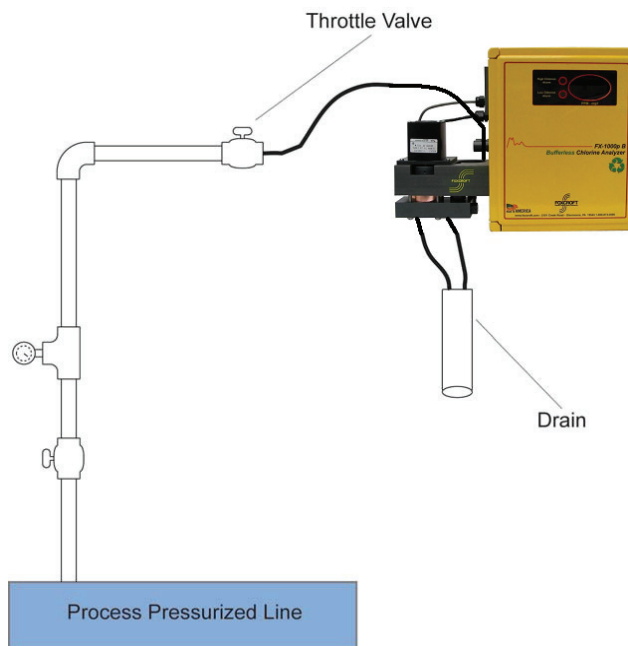


Figure 5

Reservoir Application

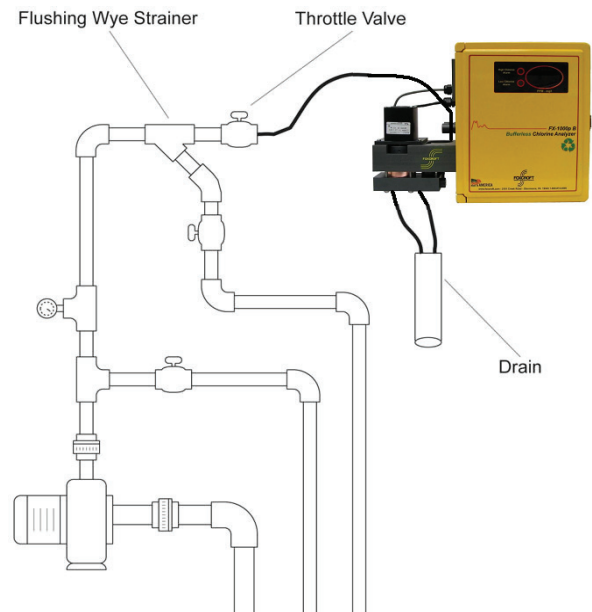


Figure 6

Non-Continuous Flow Application

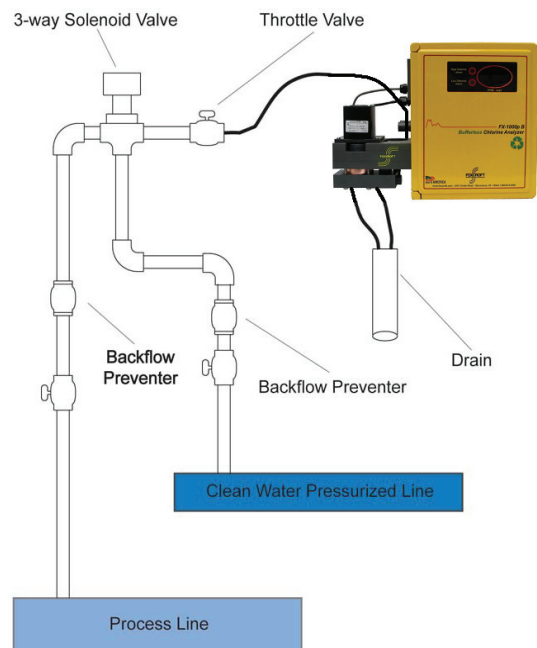


Figure 7

Carbon Filter Installation

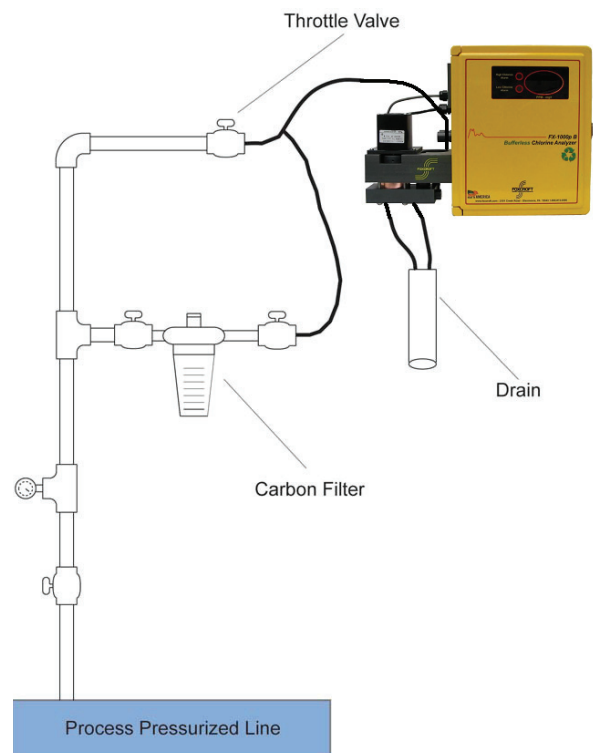


Figure 8

1.7 Installation (Electrical)

Conduit Holes

Run all wiring in 1/2-inch, grounded metal conduit. If using only shielded cable, appropriate strain reliefs or cable grips are required. Seal unused cable entry holes with appropriate plugs.

NOTE: Use NEMA 4-rated fittings and plugs to maintain the watertight integrity of the NEMA 4X enclosure.

Important: The electronics enclosure is not a junction box and should not have any other wiring running through it.

Important: This non-metallic enclosure does not automatically provide grounding between the conduit connections. Grounding must be provided as part of the installation.

1.7 Electrical Connections

Make electrical connections to terminal strips located on the bottom circuit board in the enclosure. To access this board, unfasten the thumb nuts on the four threaded standoffs, and carefully remove the cover plate and top display/controls circuit board. Make sure that the ribbon interconnect cable remains securely attached at both ends. If you prefer to remove the top circuit board and disconnect the ribbon interconnect cable to make power connections, do so with extreme care to prevent bending the ribbon interconnect cable connector pins.

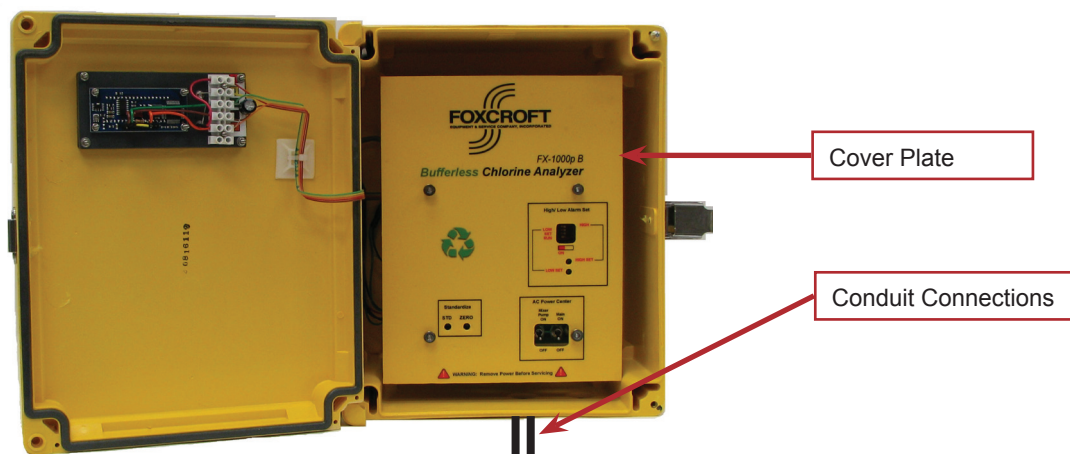


Figure 9

1.7.1 AC Power

TB-1D AC power input terminal is shown below. Use maximum 14 gauge stranded wire only. Do not use solid wire. Always connect to an earth ground.

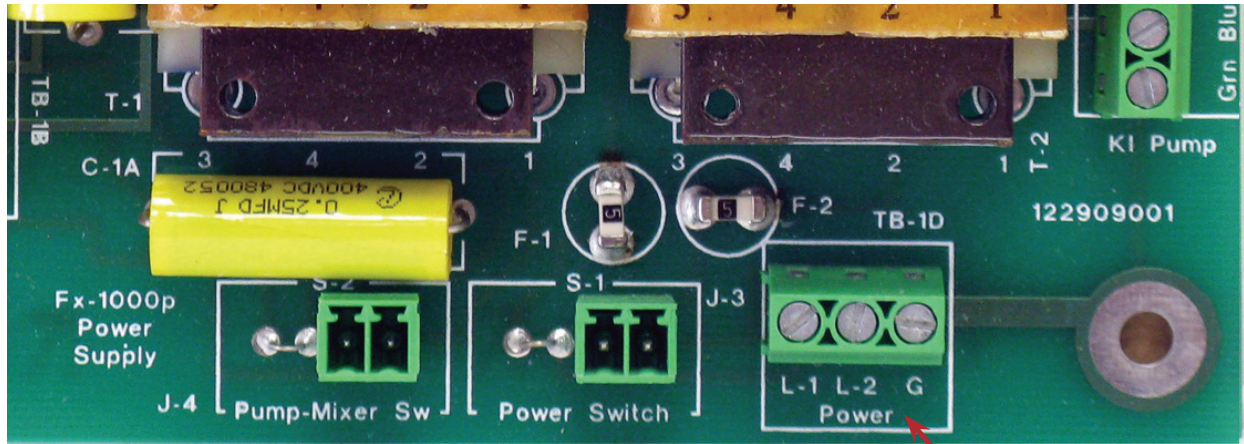


Figure 10

110/220 VAC INPUT

1.7.2 Analog Output 4-20mA

The isolated 4-20mA output signal is provided at terminals on TB-1E. This output can drive a load of up to 600 ohms. Connect the load device, matching polarity as indicated.

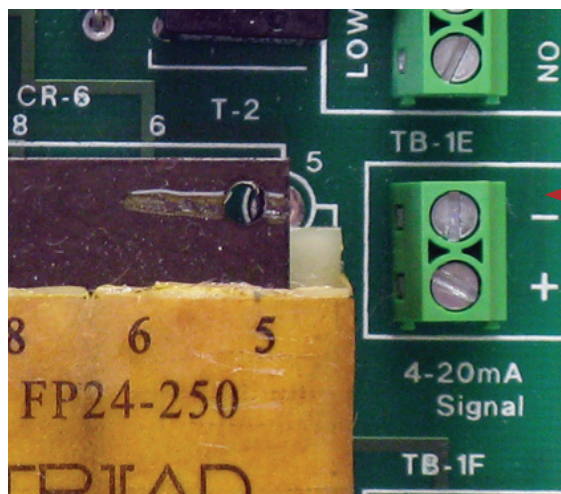


Figure 11

4-20MA Analog Output

NOTE: Do not run line voltage and low level signal voltage in the same conduit.

1.7.2 High and Low Alarm Relay Outputs:

The FX-1000p-B is equipped with two electromechanical relays. Two sets of SPDT relay outputs, one for high alarm and one for low alarm. They energize upon alarm conditions and are located on the bottom circuit board.

The relay outputs are not powered. The line power used to power the system may also be used to power the alarm or control devices with these relay contacts. Always check control wiring to ensure that line power will not be shorted by the relay switching action, and that wiring conforms to local codes.

Important: Do Not Overload Relays. 1 amp Maximum, @ 125 VAC. Circuit Board damage will occur if relays are overloaded.

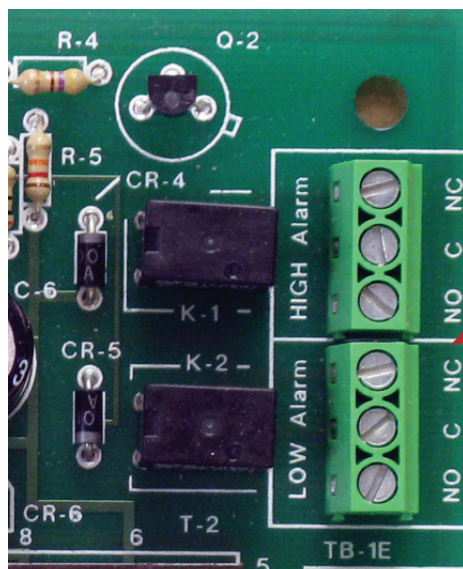
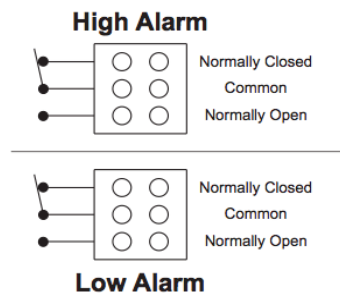


Figure 12



Do not exceed contact rating for each relay (1A @ 120 VAC).

Figure 13

1.7.3 Connecting a Chart Recorder:

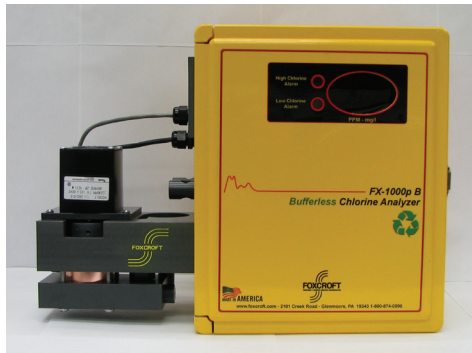


Figure 14



Recorder must be configured for 4-20mA input signal. See Model FX-4300 instruction manual.

Electrical Schematic

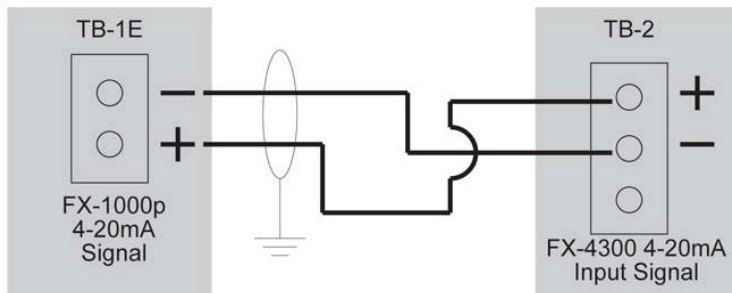


Figure 15

1.7.4 Connecting a Telephone Dialer:

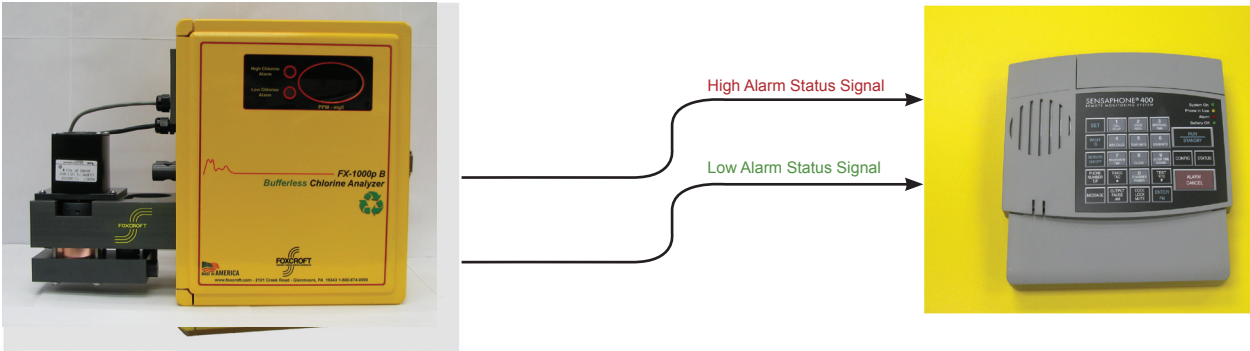


Figure 16

See Model FX-1104 or Model FX-1108 instruction manuals.

Electrical Schematic

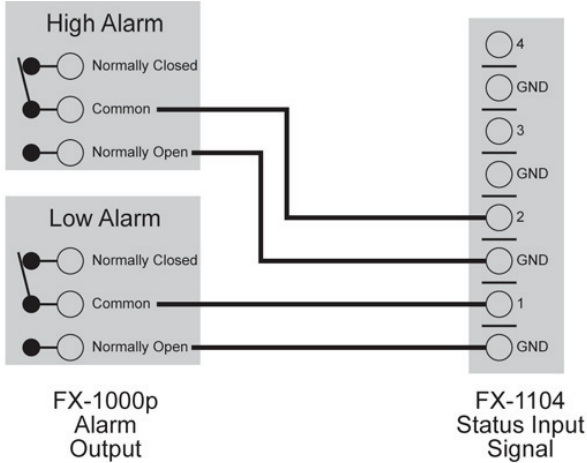


Figure 17

1.7.5 Connecting a Metering Pump:

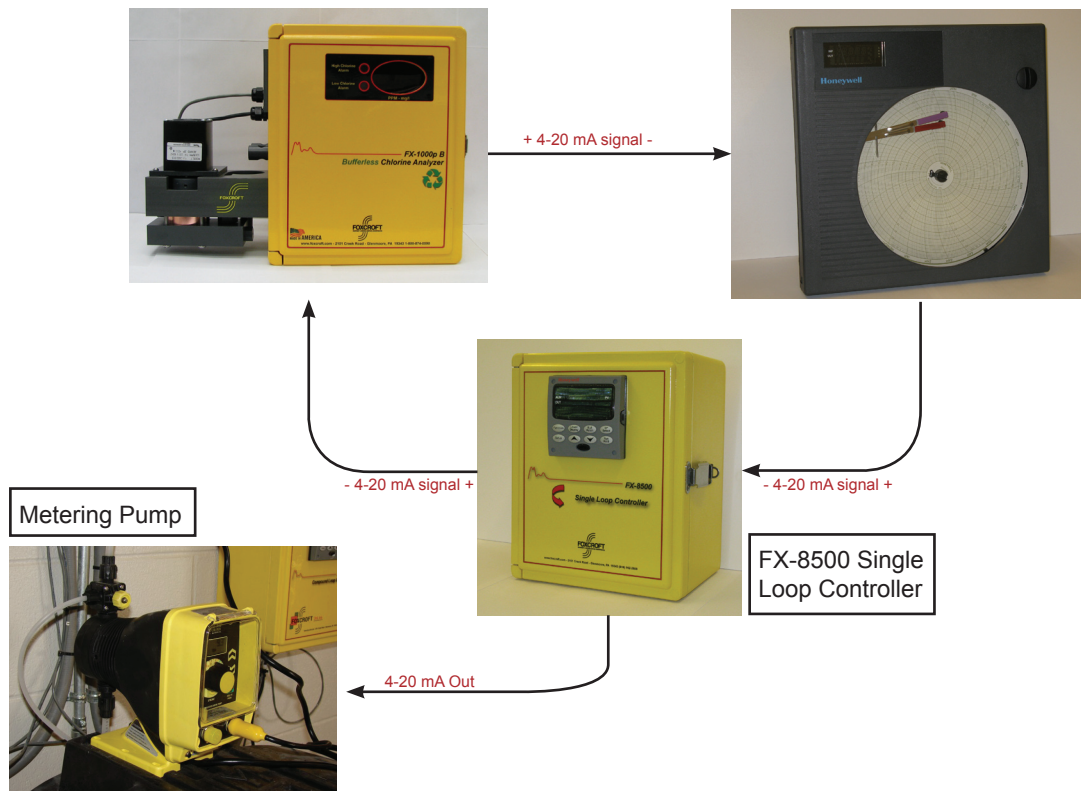


Figure 18

Electrical Schematic

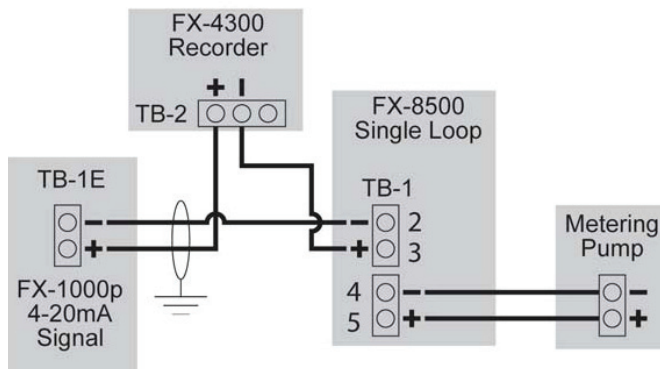


Figure 19

1.7.6 Connecting a Compound Loop Control System:

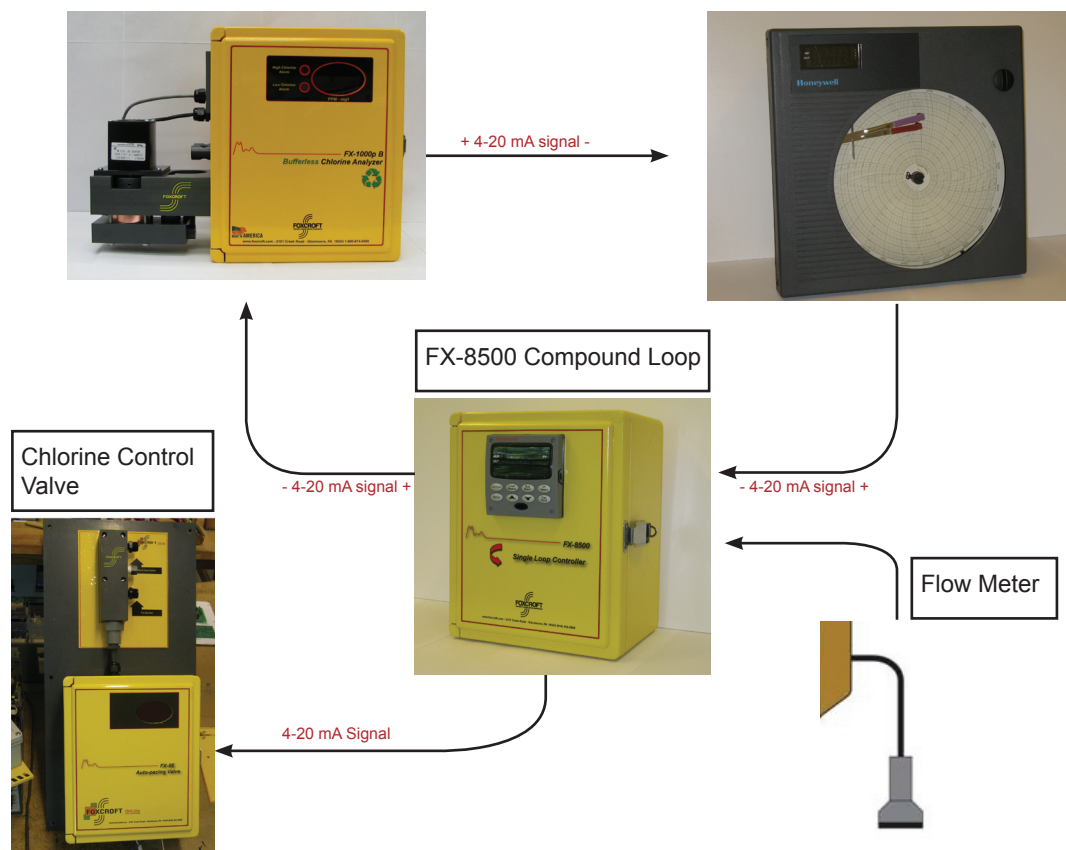


Figure 20

Electrical Schematic

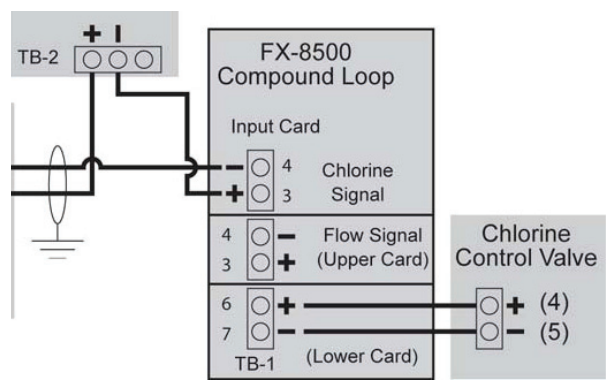


Figure 21

2 Startup

2.1 Preparing the Copper Electrode

It is recommended to polish the inside of the copper ring as it is 99% pure copper and will probably be somewhat tarnished due to normal atmospheric oxidation.

The inner surface of the copper electrode ring must be de-oxidized (i.e. polished to a bright metal shine) to obtain a strong measuring signal and accurate readings. During normal system operation with sample flowing, the process chlorine, vinegar buffering agent and scrubber mixing balls in the flow cell will keep the inner surface of the copper electrode ring shiny.

See pages 36-37 for instructions on disassembling the sample flow cell to check the copper electrode ring, and polish it if necessary.

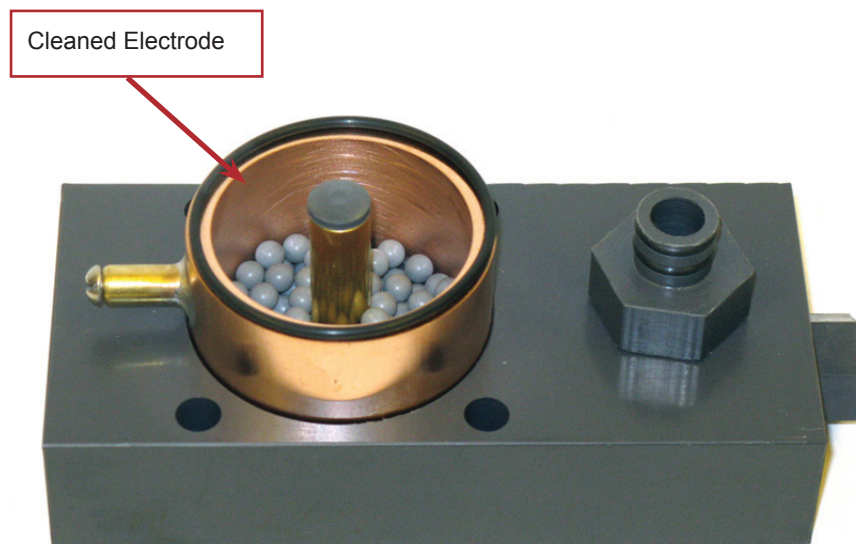


Figure 22

2.2 Preparing System for Calibration

1. See **Figure 23** (below) to be sure sample tubing is placed in the weir properly.
2. Start water sample flowing at the recommended rate of approximately 500 ml (1 pint) per minute. Water must be flowing over the sample flow cell's fixed overflow weir and through the sample drain hose on the right-hand side of the block.

Even more important is to make sure that water is flowing from the sample cell drain on the left hand side of the block. Minimum flow should be about 130 ml/min.

CAUTION: Insufficient flow from the sample cell drain indicates that either the flow is set too low or there is an internal flow blockage to the sample cell. Insufficient water flow can cause the positive electrode to overheat and become permanently damaged.

3. Locate the master switch and mixer switch, and set both switches to the on (up) position (**Figure 25**, below).
4. Allow 2 full hours for the cell to stabilize (field burn-in). If the analyzer has not responded after 2 hours of operation, shock the sample flow cell by pouring 1 ml of household bleach into the sample water in the overflow weir. Then allow 30 minutes for the analyzer to stabilize. When adding bleach, the display should move up.

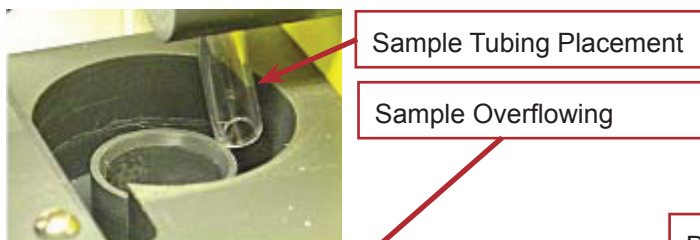


Figure 23



Figure 24

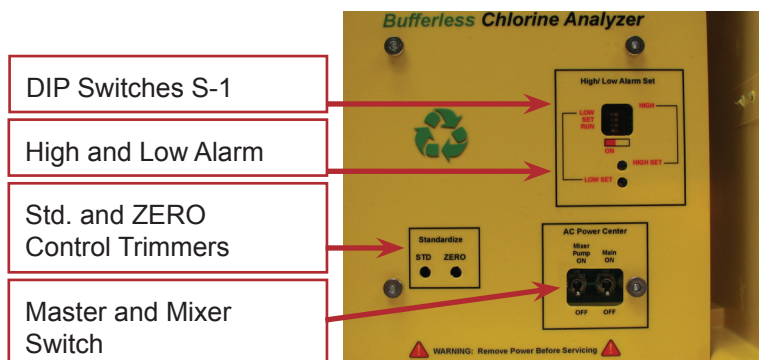


Figure 25

3 Calibration

3.1 Setting ZERO Point

1. Send an unchlorinated water sample to the sample flow cell of the FX-1000p-B Bufferless Amperometric Analyzer. Make sure that the unchlorinated water sample is the only sample going to the sample flow cell and being measured by the FX-1000p-B.

If turning off the chlorination system is not possible to obtain an unchlorinated water sample, a carbon filter should be used. See page 12 for suggested plumbing. Do not use distilled or deionized water, use unchlorinated process water.

2. Wait 15 minutes for the cell unit to stabilize.
3. Check the unchlorinated sample with an accurate chlorine residual test instrument such as the FX-1200 Chlorine Test Kit.
4. Locate the ZERO control (VR-1; see **Figure 29**, page 25). Adjust the ZERO control until the FX-1000p-B display reads 0.00 ppm (+/- 0.01 ppm).
5. Wait 10 minutes and recheck the ZERO setting. If necessary re-adjust the ZERO control to 0.00 ppm reading (+/- 0.01 ppm).

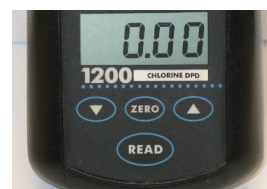


Figure 26

Establishing a proper ZERO set is the key to accurate measurement.

3.2 Setting Chlorine Standard (Std.)

1. Divert the sample flow cell back to receiving the chlorinated water sample. Wait 10 minutes for the sample flow cell to stabilize.
2. Use an accurate chlorine residual test instrument (such as the FX-1200) to determine the residual chlorine of the water sample.
3. See **Figure 29** (page 25) to locate the Std. control (VR-2), and adjust it until the FX-1000p-B display reads the known, ppm value. **If the Std. control is out of adjustment refer to “Coarse Adjustment” on page 23.**
4. Wait 10 minutes and recheck the residual chlorine value of the water sample.
5. Wait 30 minutes and repeat the ZERO control and Std. control adjustment procedures, if necessary, to minimize interaction between the controls.



Figure 27

3.3 Coarse Adjustment

The coarse adjustment is only necessary if one of the two following cases is found during Std. Control adjustment.

1. Both the Std. Control trimmer (VR-2), and the Coarse Span trimmer (VR-3), are at maximum (both fully clockwise), and the analyzer cannot be calibrated high enough to match the chlorine residual test.
2. Both the Std. Control trimmer (VR-2), and the Coarse Span trimmer (VR-3), are close to minimum (both almost fully counterclockwise), and the analyzer Std. Control is too sensitive to match the chlorine residual.

3.3.1 Input Range Adjustment To adjust the input range, it is necessary to return the Std. Control and Coarse Span trimmers (VR-2 and VR-3) to normal starting positions.

1. Turn both VR-2 and VR-3 fully counterclockwise to their “clicking” endpoints (or 30 full turns).
2. Adjust VR-2, 15 turns clockwise.
3. Adjust VR-3, 15 turns clockwise.

Follow the directions for setting ZERO Control on page 22, but use the following adjustment for span (Std. control), instead of the normal procedure. See **Figure 29** (page 25) for trimmer locations.

After determining the actual chlorine residual with an accurate chlorine residual test instrument, make the adjustment on the Input Range trimmer (VR-4), instead of the Std. Control, but set it higher than necessary to give the input potential some working range. This will leave room to go up, if necessary, on any future calibration adjustments. Counterclockwise = up. Clockwise = down.

Example: if the new analyzer range is 0-1.00 ppm and the actual residual test shows 0.70 ppm, then set the Input Range trimmer VR-4 to read 1.00 ppm. Then make the final adjustment to match the actual residual (ex: 0.70 ppm) on the Coarse Span adjustment VR-3. Fine adjustments, if necessary, can now be made on the Std. Control trimmer. The analyzer is now ready for use. Future calibration adjustments can be done as per normal “Setting Std. Control and Setting Zero Control” directions.

3.4 Low Range Calibration

In cases of low range calibration (usually 0-2 ppm or below) in conjunction with very high sample pH, total alkalinity, calcium hardness, or a combination of these, there may not be enough cell potential to get a high enough standard calibration. In these cases, VR-3 should be carefully desoldered and removed from the amplifier board. This should not be attempted, however, until all other procedures have been exhausted. In these cases, factory consultation is recommended.

In high total alkalinity samples there may still not be enough sensitivity to reach the desired set-point even after the VR3 trimmer is removed. A modification to existing amplifier boards is available to resolve this problem. New chlorine residual analyzers with 0-1 ppm operating range or less include this Low Range Sensitivity option (**Figure 28**, below).

To Calibrate Using The Low Range Sensitivity Amplifier Board

1. Turn Standard Adjustment (trimmer VR2) and Input Range Adjustment (trimmer VR4) to their mid points. Do this by turning the trimmers fully counterclockwise until they “click” at their endpoints, 30 turns. Then turn clockwise 15 turns.
2. On the amplifier board, locate the 4-position Low Range DIP switch located just above the standard and zero adjustment (fig. 1). Slide switch number one left to the “On” position, it will remain there. Switches two through four remain in the “Off” position to the right.
3. After determining the actual chlorine residual with an accurate chlorine residual test instrument, adjust Input Range Adjustment trimmer VR4 to that point or slightly higher to give the input potential some working range (e.g., if the analyzer range is 0 – 1.00 ppm, and the actual residual test result is 0.70 ppm, set trimmer VR4 so the analyzer displays 1.00 ppm).
4. Make the fine adjustment using Std. control trimmer VR2 until the analyzer displays the known ppm value.

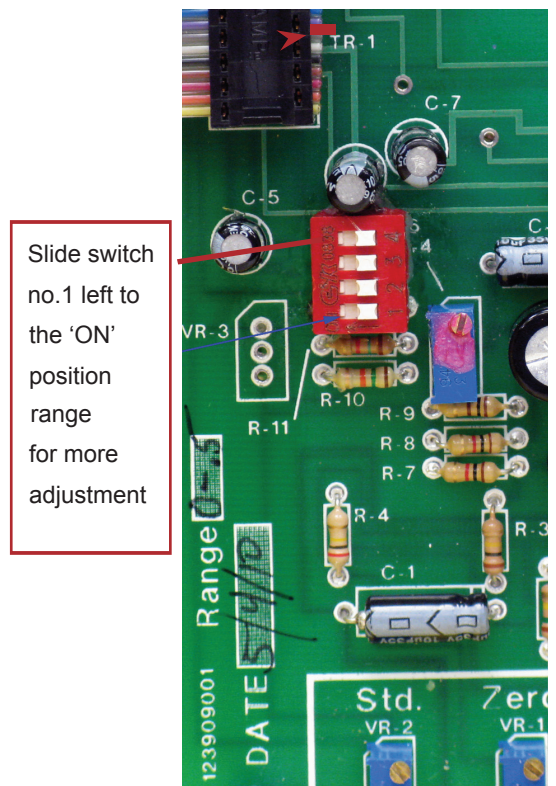


Figure 28

4 Special Configurations

4.1 Trimmer Locations

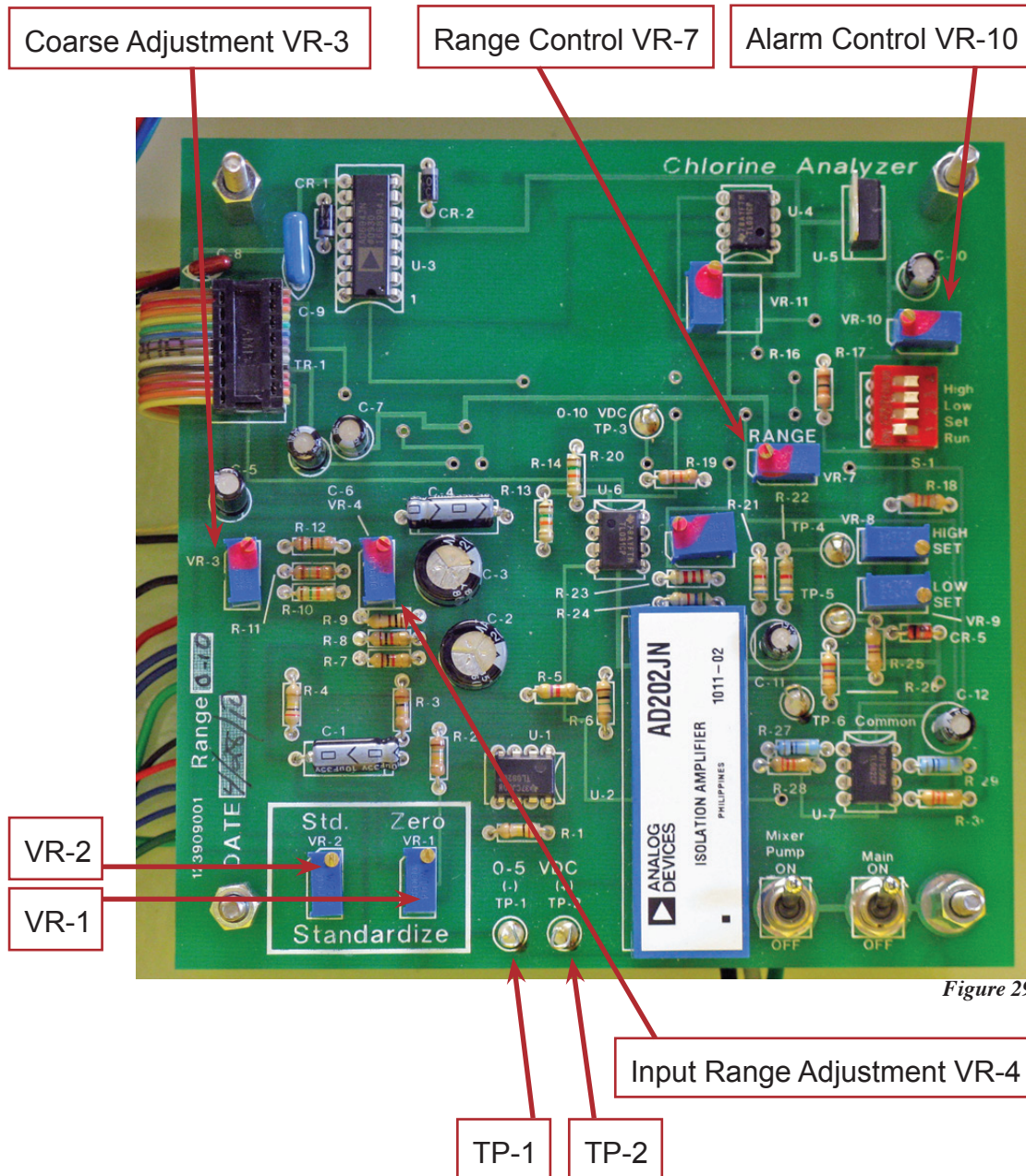


Figure 29

4.2 Setting Alarm Relays

Before setting the relay alarm points, make sure that the FX-1000p-B Amperometric Chlorine Residual Analyzer is calibrated.

1. Locate the block of four DIP switches (S-1; see **Figure 30**, page 27), and set the switches to these settings.

<u>Switch</u>	<u>Setting</u>
High switch	"off" (right) position
Low switch	"on" (left) position
Set switch	"on" (left) position
Run switch	"off" (right) position

Adjust the low set control VR-9 until the FX-1000p-B display indicates the desired low alarm point value.

2. Locate the block of four DIP switches (S-1; see **Figure 30**, page 27), and set the switches to these settings.

<u>Switch</u>	<u>Setting</u>
High switch	"on" (left) position
Low switch	"off" (right) position
Set switch	"on" (left) position
Run switch	"off" (right) position

Adjust the high set control VR-8 until the FX-1000p-B display indicates the desired low alarm point value.

3. Locate the block of four DIP switches (S-1; **Figure 30**, page 27), and set the switches to these settings.

<u>Switch</u>	<u>Setting</u>
High switch	"off" (right) position
Low switch	"off" (right) position
Set switch	"off" (right) position
Run switch	"on" (left) position

Now it's set in the run mode to analyze/monitor.

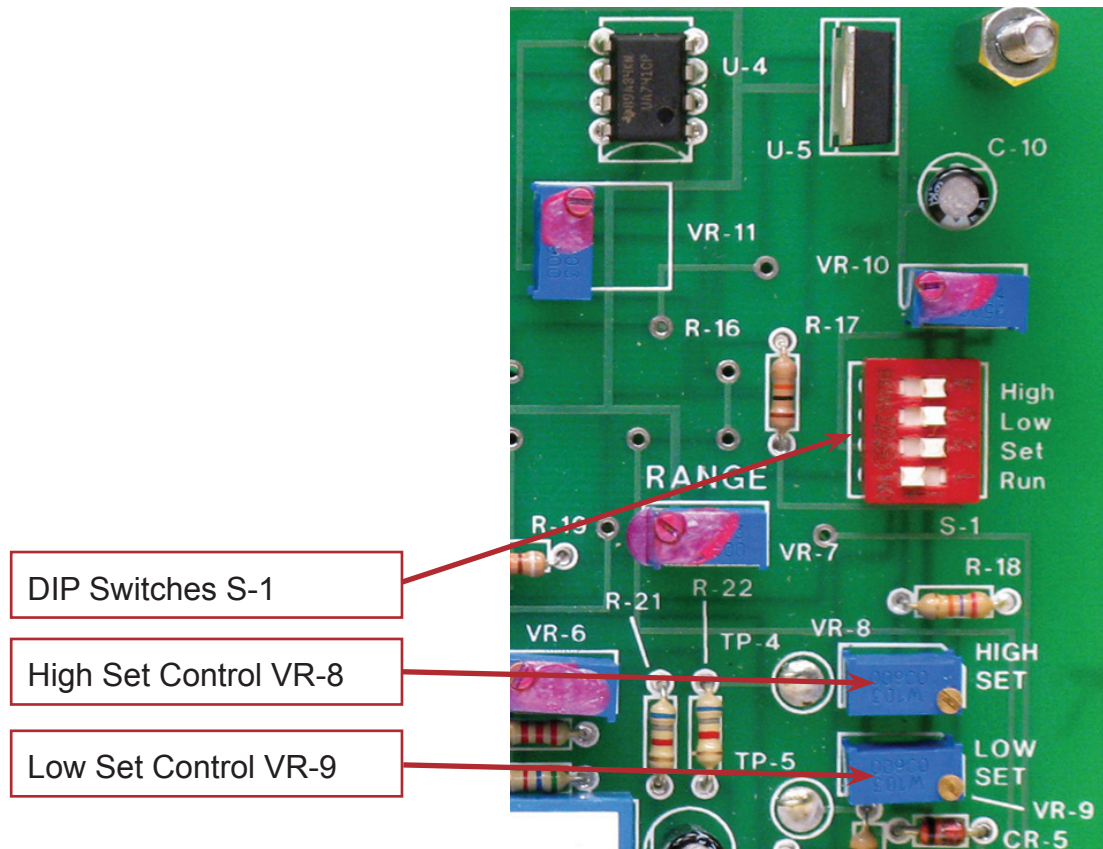


Figure 30

4.3 Changing Measuring Range

The measuring range of the FX-1000p-B is factory set to 0-5.00 ppm. It can be changed in the field to one of these other ranges:

- 0-0.50 ppm (mg/l)
- 0-1.00 ppm (mg/l)
- 0-2.00 ppm (mg/l)
- 0-3.00 ppm (mg/l)
- 0-10.0 ppm (mg/l)
- 0-20.0 ppm (mg/l)
- 0-50.0 ppm (mg/l)
- 0-60.0 ppm (mg/l)

Certain range changes will only require a decimal point shift such as from 0-5.00 ppm to 0-50.0 ppm or 0-0.50 ppm. Other range changes such as from 0-5.00 to 0-10.0 ppm will require a decimal point shift and the re-ranging procedure. A change from 0-5.00 ppm to 0-2.00 ppm would not need a decimal shift, but would need the re-ranging procedure (see page 29).

Regardless of the range change, even if it's only a shift in the decimal point, always calibrate the FX-1000p-B after changing the measuring range.

All the adjustments used on the amplifier board of the analyzer are made using 30-turn trimmers. At either end of the 30 turns there is a ratchet type "click" sound that indicates the end of travel has been reached. You can also count 30 full turns in either direction to reach the end of travel.

The ZERO control adjustment runs the full internal range of the analyzer and, as such, can be used as a built-in chlorine residual simulator for re-ranging or testing.

4.3.1 *Shifting the Decimal Point*

If the new measuring range only requires a decimal point shift (e.g., from 50.0 to 5.00 ppm) simply move the jumper on the back of the display circuit board.

Refer to **Figure 31** (below) and move the yellow jumper to the appropriate pin position. Please note the orientation of the display in the photo below. With the display installed in the analyzer, the yellow jumper would be moved in a direction opposite from the view shown.

Move the yellow jumper wire to shift the display decimal point

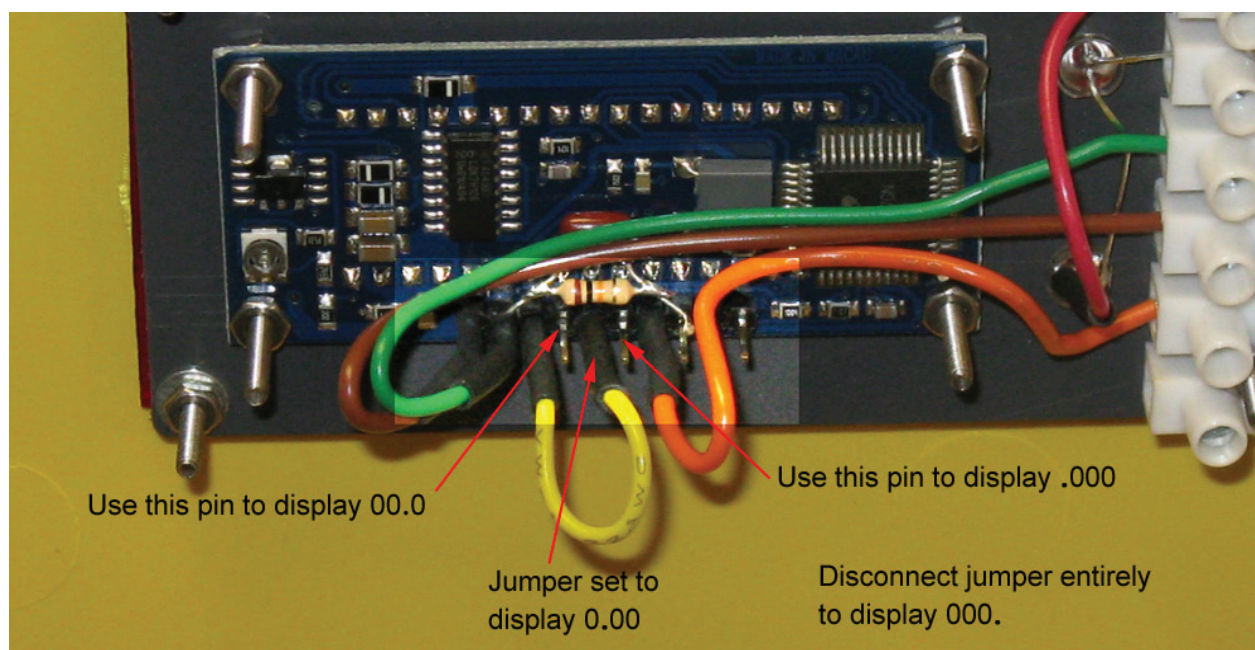


Figure 31

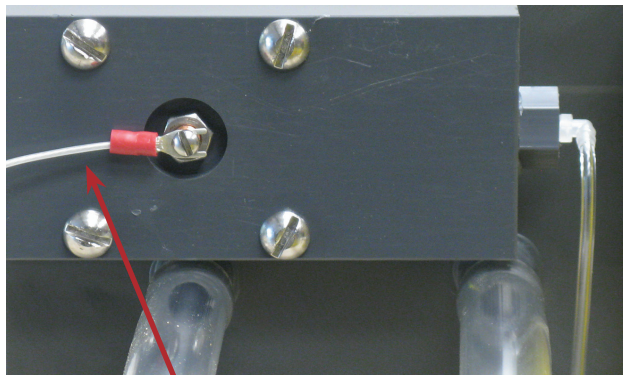
Re-ranging

See **Figure 29** (page 25) for trimmer locations.

1. With the system operating, remove the white wire from the positive electrode, on bottom of the cell block (**Figure 32**, below).
2. Adjust the ZERO control (VR-1) so the display shows the existing maximum range of the analyzer (e.g., 5.00 ppm).

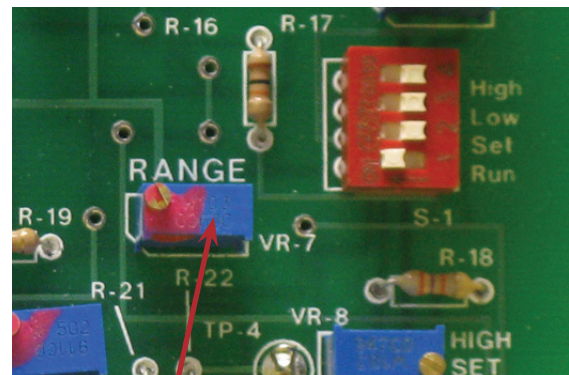
If the existing high endpoint is not known, adjust the ZERO control to read 5.00 VDC on a digital voltmeter connected across test points TP- 1 and TP-2, or to read 20.00 mA on a digital milliamp meter wired in series with the FX-1000p-B analog output signal. The milliamp method ensures an accurate output calibration to the new analyzer range.

3. Adjust the range trimmer (VR-7) until the FX-1000p-B display reads the high endpoint of the new range (e.g., 1.00 ppm).
4. Re-adjust the ZERO control until the FX-1000p-B display reads 0.00 ppm.
5. Re-attach the white wire to the positive electrode.
6. Always calibrate the system for the new measuring range (pages 22-24).



Positive Electrode Wire

Figure 32



Range Control VR-7

Figure 33

See pages 26-27 for instructions on resetting Alarm Relays

4.4 Setting 4-20mA Output

The display has a dampening circuit that slows the response of the display. The output signal will not show the same dampening effect. Allow time for the display to match the output signal when calibrating.

1. Disconnect the white wire from the positive electrode on the bottom of the cell block (**Figure 32**, page 29).
2. Connect an accurate digital milliamp meter in series with the 4-20mA output loop, or directly to the output terminals if there is no existing connection to the output signal.
3. Adjust the ZERO trimmer (VR-1) so that the output is exactly 4.00mA (clockwise).
4. If the display is not showing exactly 0.00 make the appropriate adjustment at VR-11.
5. Re-adjust the ZERO trimmer (VR-1) so that the output is now exactly 20.00mA (counterclockwise).
6. Adjust the range trimmer (VR-7) so that the display shows the desired maximum range of the analyzer (e.g., 1.00 ppm).
7. Re-adjust the ZERO trimmer (VR-1) back for 4.00mA output.
9. Re-attach the white wire to the positive electrode.
10. Always calibrate the system after adjusting the 4-20mA output.

5 Maintenance

5.1 Preserving measurement accuracy

The FX-1000p-B Bufferless Amperometric Chlorine Analyzer is designed to operate continuously, 24 hours a day, 365 days a year. The system requires little routine maintenance.

The sample cell of the analyzer has 150 PVC balls that are constantly rotated against the copper ring and gold electrode by a 120 rpm motor with a mixing arm attached to it. This action provides automatic cleaning of the cell and sample consistency within the cell.

However, regular maintenance should be performed to ensure that optimum performance, accuracy, and repeatability remain in compliance. The frequency required varies by water quality and the residual maintained.

Please note that the copper negative cell will erode more rapidly as free chlorine residual increases, and will therefore require more frequent replacement. A higher erosion rate can also occur in corrosive water with typical free chlorine residual levels.

The maintenance schedule below is recommended. Some applications may require more sample flow cell maintenance due to high suspended solids, high calcium levels, or other characteristics of the sample liquid.

5.2 Maintenance Schedule			
	<i>Potable Water</i>	<i>Waste Water</i>	<i>Chlorine Residual 20 ppm or more</i>
<i>Visual Inspection</i>	Once per week	Once per week	Once per week
<i>Verify Calibration</i>	Once per week	Once per week	Once per week
<i>Clean the Negative Cell</i>	Every 6 months	At least once per month	Once per month if needed
<i>Install PM Kit</i>	Once per 12 months	Once per 12 months	Once per 12 months
<i>Clean the Positive Electrode</i>	Once per 12 months if needed	Once per month if needed	Once per 12 months if needed
<i>Inspect Electric Connections for Corrosion</i>	Once per 12 months	Once per 12 months if needed	Once per 12 months if needed
<i>Clean Sample Flow Cell</i>	Once per 12 months if needed	Once per 6 months if needed	Once per 12 months if needed

High levels of suspended solids, such as those found in a waste treatment plant, may collect in the bottom of the cell or coat the copper electrode ring. This condition can be reduced or eliminated

by installing a “flushing wye strainer” in the sample line just before it reaches the FX-1000p-B. The strainer is particularly well suited for high suspended solids applications. It has a built-in flushing port that can be plumbed to a drain, or back to the process. This type of flushing port can be left partially open to minimize cleaning intervals. The screened outlet of the strainer can then be plumbed to the sample flow cell.

High calcium and iron levels in the sample can precipitate out onto the copper electrode ring and other surfaces contacting the sample. This can adversely affect conductivity and the accuracy of chlorine residual measurements.

The calcium or iron deposits can be removed with muriatic acid, which is available at most hardware stores. (Use all applicable safety procedures when using any strong acid.) Any buildup on the copper electrode ring can be removed by polishing with a Scotch Brite pad, 100 grit emery cloth, or steel wool.

Do not use any cleaning compounds that contain chlorine.

For Drinking Water Applications, PLEASE NOTE:

When maintenance is performed, the accuracy of the analyzer must be verified with a grab sample comparison after the analyzer is placed back in service. The accuracy must be verified again after one day of operation. If the accuracy criteria are not met and the analyzer is operating properly, adjust the analyzer calibration (pages 22-24).

5.3 Cleaning The Copper Electrode

Always polish the copper electrode ring whenever the electrode:

- Is exposed to the atmosphere for more than a week (oxide/tarnish buildup occurs on new or out of service systems).
- Has been used for about 12 months of normal operation (electrode usually oxidizes/tarnishes enough during this period to degrade measurement performance).
- Acquires a precipitate buildup due to sample characteristics such as high calcium.

5.4 Removal & Assembly: follow these steps to clean the copper electrode.

1. Turn off the power source and stop the sample flow to the system.
2. Remove the flushing plug and allow the sample flow cell to drain.
3. Disconnect the wires from the copper electrode ring and the gold electrode.
4. While holding the bottom block of the flow cell, unfasten and remove the four bottom screws of the assembly.

NOTE: Do not loosen or remove the nut centered between the four bottom screws. This could damage the expensive gold electrode that is press fit and specially sealed onto the lower block.

5. Carefully pull the bottom block, together with the copper electrode ring, down from the top block. This should help prevent losing any of the 150 small PVC mixing balls contained within the copper ring electrode.

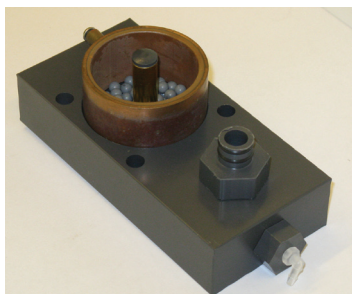
NOTE: During removal, be careful not to lose the O-ring that seals the top edge of the copper electrode ring to the top block of the flow cell.

6. Pour the PVC balls into a container.
7. Remove and set aside the upper and lower O-ring seals. If they are damaged, replace them.
8. Use medium sandpaper (100 grit) or Scotch Brite pad to shine the inner surface of the copper electrode ring.

NOTE: Do not use any commercial abrasive cleaning powders or liquid, as they contain chlorine and will leave a residual coating that will adversely affect system performance.

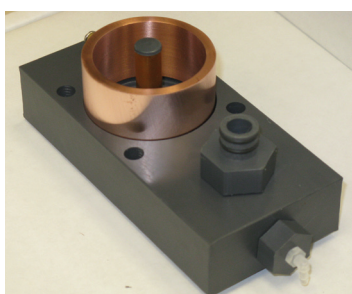
NOTE: If the copper electrode ring is excessively scratched or has an uneven surface, it should be replaced.

9. Inspect the PVC balls for flat spots or dents. Replace any damaged balls.
10. Inspect the flow nozzle orifice for any precipitate buildup or obstructions, and clean if necessary.
11. Inspect the O-rings for damage and replace if needed.
12. Inspect the flushing plug orifice and check for any precipitate buildup or obstructions, and clean if necessary. Inspect the O-rings for damage and replace if needed.
13. Re-assemble the sample flow cell.



Before Cleaning

Figure 34



After Cleaning

Figure 35

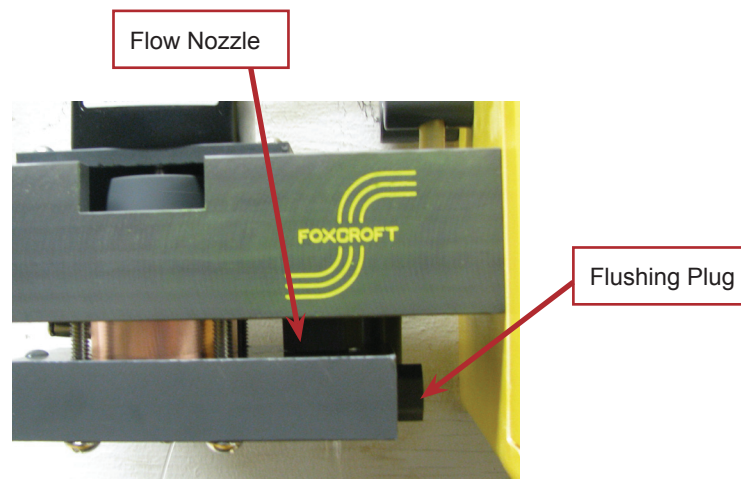


Figure 36

5.5 Mixer Gap Adjustment

Maintaining the proper clearance between the bottom tips of the mixer and the floor of the sample cell is critical to prevent premature mixing motor failure.

If the gap is too high the mixing balls become jammed under the tips of the mixer, and/or come out of the top of the cell through the sample water exit gap. If the mixer is set too low it will rub against the floor of the sample cell. Either situation can damage the mixing motor. Intermittent mixer motor stopping or reversal can be a symptom of these problems.

These same symptoms can also be caused by a worn copper ring, where the wall thickness has diminished such that the mixing balls get jammed between the side of the mixer and the inside wall of the copper ring. This latter condition would require replacement of the copper ring, in addition to the gap adjustment described here.

The mixer clearance gap must be checked and adjusted to $5/32$ " mixing motor whenever any integral part of the sample cell has been replaced, such as the mixer motor, the copper ring, or the O-rings.

Tech Tip: Use a $5/32$ " drill bit to set the gap between the mixer and mounting plate.

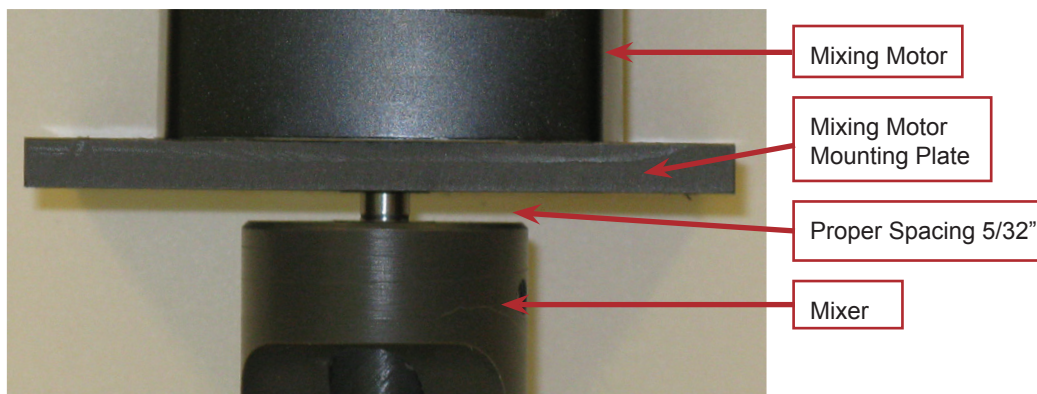


Figure 37

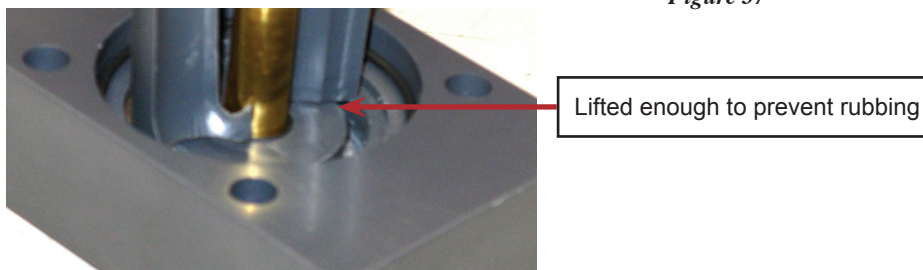


Figure 38

Preventive Maintenance Kit

5.6 Preventive Maintenance Kit Installation

The Preventive Maintenance Kit includes:

Item Number	Qty	Description	Part Number
1	2	O-ring #31	129-0031-0121-1
2	1	PVC Mixing Balls (150 ct)	119-0371-0001-1
3	2	O-ring #14	129-0014-0001-1
4	4	O-ring #12	129-0012-0001-1
5	1	Mixer	168-0242-0121-3
6	1	Negative cell (copper electrode)	159-0263-0001-2

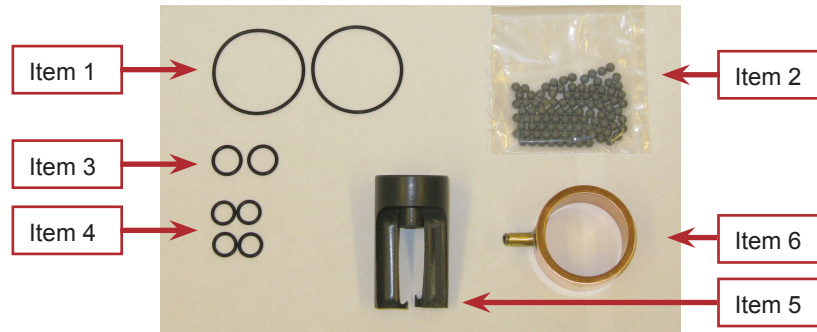


Figure 39

The best way to perform preventive maintenance on the analyzer is to remove it from the wall and place it upside down on a table. Even with the disconnections needed to remove the analyzer you will be able to work more quickly and accurately by avoiding potential problems such as dropped parts and mixing balls jamming under the mixer.

5.6.1 Parts Removal

1. Turn off the power source and stop the sample flow to the system.
2. Disconnect the power and signal wires at the power supply board, and pull them out of the conduit holes.
3. Disconnect the water sample supply line.
4. Remove flushing plug.

If you prefer to leave the analyzer mounted on the wall follow steps 4a and 4b. Otherwise proceed to step 5.

- 4a. While holding the bottom block of the flow cell, unfasten and remove the four bottom screws of the assembly (**Figure 40**).

Caution: Do not loosen or remove the nut that secures the positive electrode unless the seal is leaking. This will break the seal of the positive electrode on the lower block.

- 4b. Carefully pull the bottom block, together with the copper electrode ring, down from the top block (**Figure 41**). This should help prevent losing any of the 150 small PVC mixing balls contained within the copper ring electrode. Pour the PVC balls into a container (**Figure 42**). Proceed to step 11.

5. Remove the (4) mounting screws that hold the analyzer to the wall.
6. Place the analyzer upside down on a work bench or table.
7. Remove the (4) 1/4"-20 slotted screws that fasten the lower block to the upper block.

Caution: Do not loosen or remove the nut that secures the positive electrode unless the seal is leaking. This will break the seal of the positive electrode on the lower block.

8. Lift the lower block and lay it on the table.
9. Tilt the analyzer and pour the mixing balls into a container.

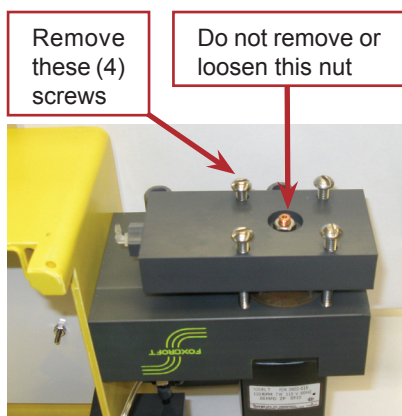


Figure 40

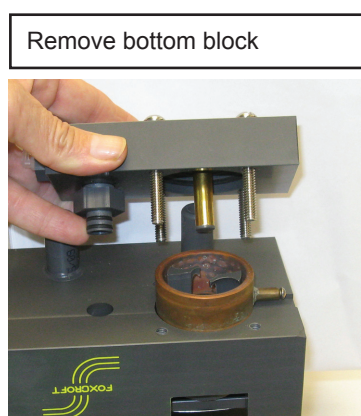


Figure 41

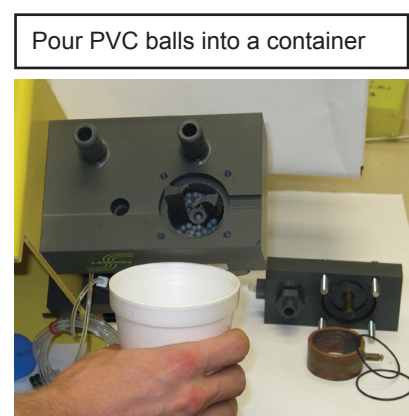


Figure 42

5.6.2 Inspection, Cleaning, Cleaning the Positive Electrode

10. Rotate the mixer by hand until the set screw is visible, remove the screw with a 3/32" Allen wrench.
11. Pull out the mixer. If it's not damaged keep it for a spare.
12. Clean the upper block of any deposits. Do not use chlorinated cleansers.
13. From the lower block remove the flushing plug and flow nozzle. Clean if necessary.
14. Remove the copper negative cell and discard.
15. Inspect and clean the lower block if necessary, including the internal ports. Do not use chlorinated cleansers.
16. Check the positive electrode (gold) and clean with a soft cloth (not an abrasive cleaning pad or sandpaper) if needed. Do not loosen or remove the electrode. If the O-ring seal is broken water can seep in between the gold tube and copper stud and prevent electrode operation. The electrode is made of pure gold tubing pressed onto a copper stud and is very easily damaged, especially by over tightening the nut that secures the electrode to the block.
17. Remove all O-ring seals: (2) for the negative cell, (4) on the flow nozzle, and (2) on the flushing plug as shown below.

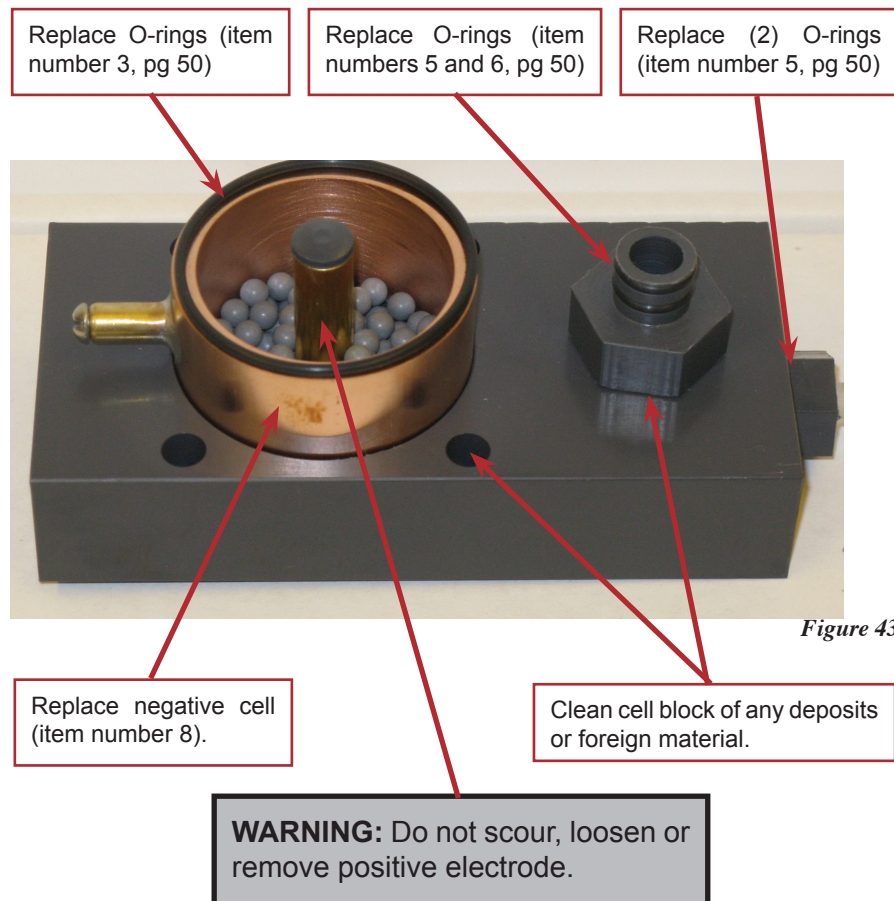


Figure 43

5.6.3 PM Kit Parts Replacement Procedure

1. Replace all of the O-rings removed. A light coating of silicone grease may be applied to the O-rings.

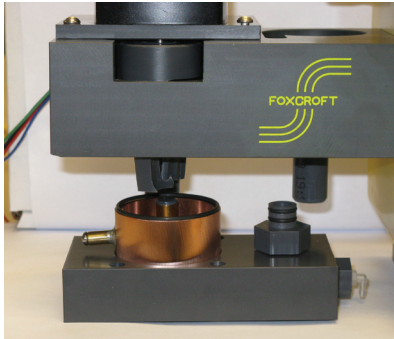


Figure 44

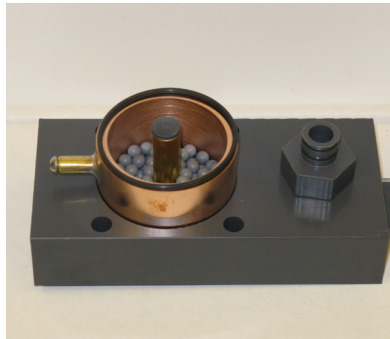


Figure 45

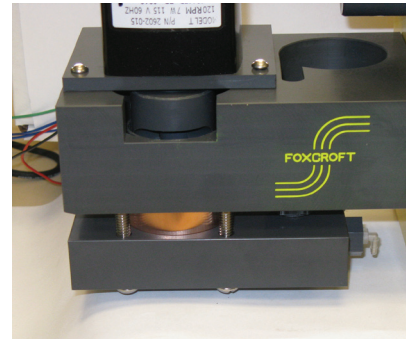


Figure 46

2. To replace the item #3 O-rings: in the lower block for the negative cell, stretch it slightly before putting it into the block. To replace the second item #3 O-ring place it into the counterbore of the large block which covers the top of the negative cell.
3. Reinsert the flushing plug and flow nozzle (tip down) into the lower block.
4. Slide the mixer onto the mixing motor shaft. Make sure the set screw lines up with the flat on the shaft.
5. To set the mixer gap place a 5/32" spacer (e.g., a drill bit) between the end of the mixer hub and the bottom of the mixing motor mounting plate. Tighten the set screw in the mixer firmly.
6. Inset the copper negative cell into the counterbore of the large block. Make sure the O-ring in the block is in place.
7. Pour the new mixing balls into the negative cell.
8. Making sure the item #3 O-ring in the lower block is in place, place the lower block onto the negative cell, push the block down until the negative cell and flow nozzle are seated with the upper block.

Tech Tip: When the flow nozzle is completely inserted into the upper and lower blocks you will still see a 1/16" gap above and below the hex portion of the nozzle.

9. Reinsert the (4) 1/4"-20 screws, tighten evenly and firmly; do not over-tighten to avoid stripping the threads in the upper block. Make sure the lower block is level and parallel with the upper block.

5.6.3 PM Kit Parts Replacement Procedure **ReReplacement** **Pro**

Re-assembling the bottom block if the analyzer is mounted on the wall:

- 9a. Rotate the mixer while inserting the bottom block into the top block. This ensures that no mixing balls get jammed under the mixer arms. Continue to rotate the mixer by hand until mixer turns freely. Insert the four mounting screws, tighten evenly and firmly. Rotate the mixer to be sure it is rotating freely. Make sure the lower block is level and parallel with the upper block.
10. Re-mount the analyzer on the wall.

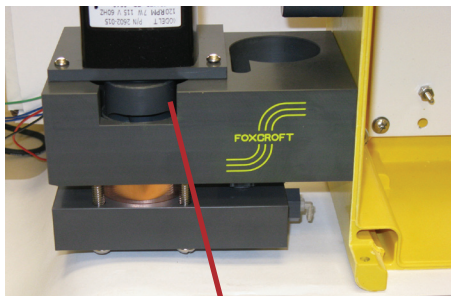


Figure 47

Rotate mixer while inserting bottom block

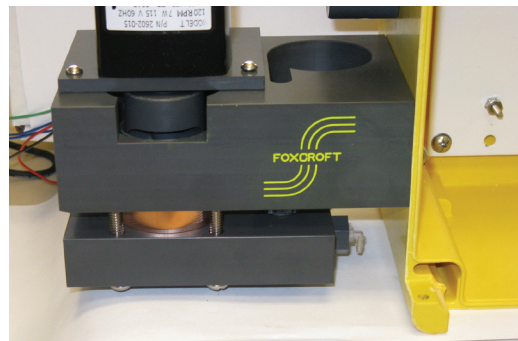


Figure 48

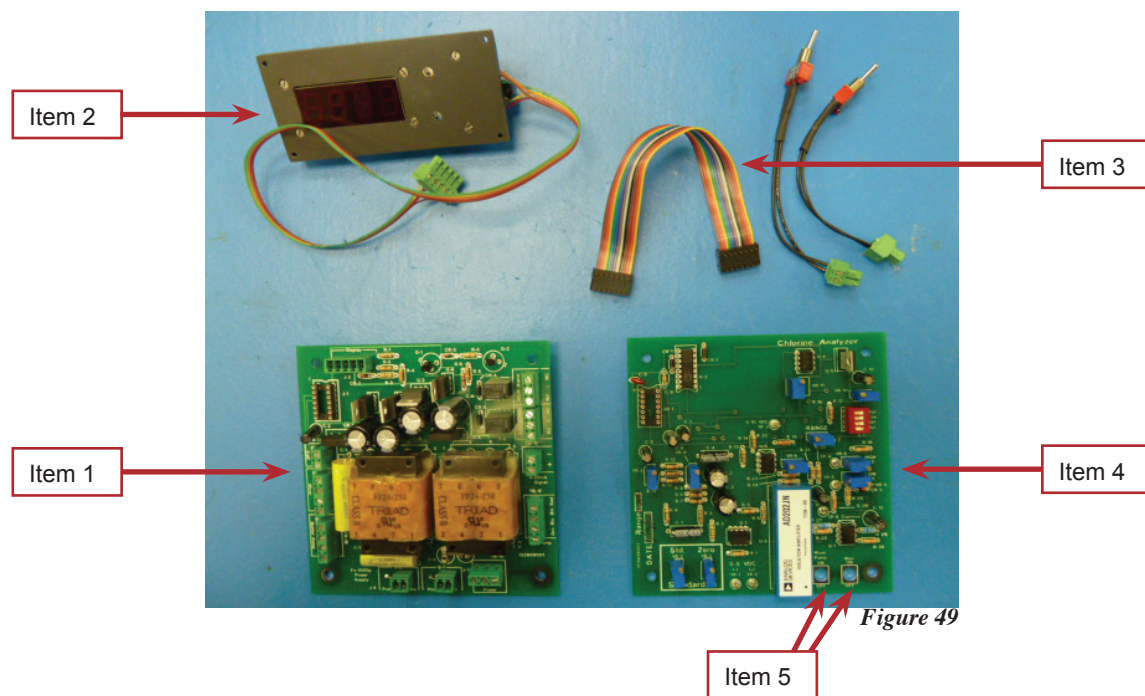
Fully assembled

11. Re-connect the signal wires to the cell unit, black wire to the copper electrode and white wire to the gold electrode.
12. Recalibrate the analyzer before returning it to service. Refer to the calibration section of this product manual on pages 22-24 for instructions on how to calibrate the FX-1000p-B.

6 Parts Listing

6.1 Electronics

Item Number	Description	Part Number
1	Power Supply 110V	356-1001-0122-2
1	Power Supply 220V	356-1220-0122-2
2	Display Board	356-0352-0122-2
3	Ribbon Interconnect Cable	356-1004-0001-2
4	Amplifier Board	356-1000-0122-2
5	Switches (2 required)	257-0115-0121-1



6.2 Amperometric Cell

Item Number	Description	Part Number
1	Top block with drain tubes	119-0120-0121-1
2	Negative cell (copper electrode)	159-0263-0001-2
3	Mixer (paddle)	356-1000-0122-4
4	Mixing Balls (150 ct)	119-0371-0001-1
5	O-ring #31 for negative cell (2 required)	129-0031-0121-1
6	Flow nozzle	130-0488-0010-1
7	O-ring #012, Viton, for flow nozzle and flushing plug (4 required + 2 spare)	129-0012-0001-1
8	O-ring #014, Viton, for flow nozzle (2 required)	129-0014-0001-1
9	Flushing plug with 2 #12 O-rings	113-0427-0003-3
10	Round head stainless steel screw 1/4"-20 x 2", lower positive electrode block	135-1420-2000-1
11	Mounting plate, mixing motor	158-0439-0002-1
12	Mixing motor 115VAC, 60Hz, 120rpm	142-1000-0002-3
13	Mixing motor 110VAC, 50Hz	257-0220-0121-1
14	Positive electrode with block	162-1441-0121-1
Not Shown	Preventive Maintenance Kit	FX-1000p PM Kit

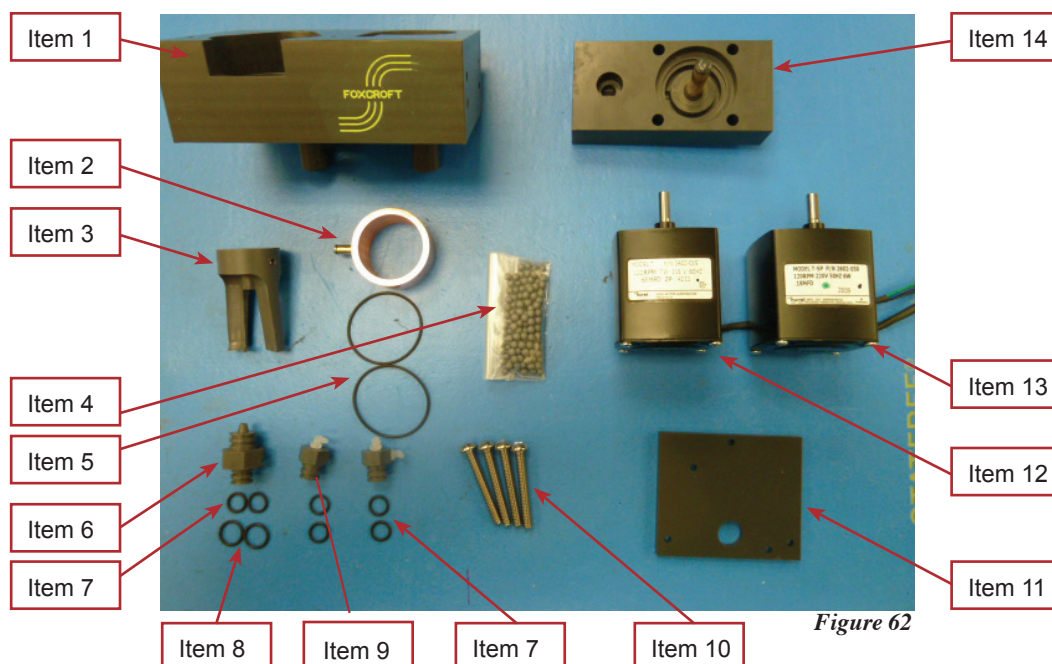


Figure 62

8 Accessories



Figure 51

FX-4300 Recorders



Figure 52

FX-1200 Chlorine Test Kits



Figure 53

FX-400 Telephone Dialer



Figure 54

FX-8500 Chlorine Controller

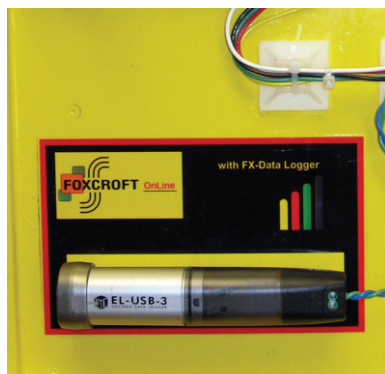


Figure 55

FX Datalogger



Figure 56

Second KI Pump

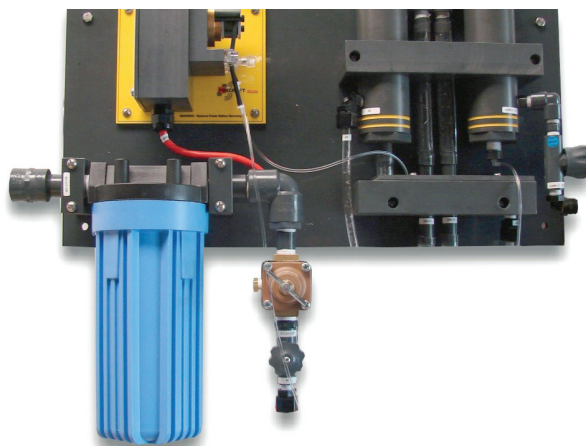


Figure 57

Dilution Panel

7 Troubleshooting

Initial Startup

On initial startup, the inside surface of the copper electrode should be cleaned BEFORE any calibration is done, due to the rapid oxidation that takes place on pure copper.

Trimmer Adjustment

All the trimmers used on the analyzer are of the 30-turn variety, so it may take several turns before you get the desired residual setting or voltage.

ZERO and Std. Interaction

The ZERO and Std. settings do interact with each other, so adjusting one setting may affect the other. You may have to go back and forth a couple of times between ZERO and Std. to get the calibration correct.

Water Sample with Contaminates

Make sure the water sample does not contain any oils, grease, or corrosion inhibitors that would coat the inside of the measuring cell, and inhibit the electrical properties of the cell.

Proper Sample Flow

Check the sample flow. There should be ample flow, so that there is a constant overflow from both drains, especially the left one, which is the drain from the sample cell. The left drain should flow at about 120 ml per minute. If there is little or no flow from the left drain, check for a blockage in the flow tube, located under the inlet sample weir, sandwiched between the upper and lower blocks. Check for air bubbles in cell inlet. Use a small screwdriver or piece of wire. Insert it into sample flow inlet. If a good flow starts, then air bubbles are the issue. Install flow regulator fitting supplied with the analyzer.

Sample Cell

Dismantle the cell as described on pages 36-37, and clean the inside surface of the copper ring. This is especially important on initial startup, as the copper is 99% pure, and it oxidizes quickly, even after only a few days of shipment to the installation site. A Scotch-Brite pad works best or you can use a 100 grit emery cloth, or a steel wool pad. Do not use a Brillo or detergent pad. If the analyzer has been in service for some time, and there is a calcium buildup on the copper ring (due to high calcium in the sample water), it can be dissolved with muriatic acid, or simply scrubbed off with sandpaper. If the sample water is oily or greasy, such as in poultry processing waters, you should pre-filter the sample. The oil or grease film on the cell can be cleaned off with most caustic based cleaners. Do not use any that contain chlorine.

Sample Cell Problems

While you have the sample cell dismantled, check all the parts including the positive electrode (refer to the positive electrode section below). There should be 150 PVC balls. If you are short a few, it's not a problem, but if it's more than a few, the cell may not stay clean. Check for damage to the PVC balls and mixer. If the mixer has damage on the tips, the balls are slipping under the mixer. This would indicate that the mixer paddle is set too high on the motor shaft. To set the gap correctly, refer to page 34. Do not forget to put the PVC balls back in the cell.

If the mixer has damage on the sides, the balls are slipping between the mixer paddle and the copper ring. This would indicate that the copper ring has reached the end of its useful life, and needs replacement. The copper ring will slowly erode over time (usually several years or more), making the wall of the ring thinner or mottled. Some sample waters are more aggressive than others, and copper ring life-span will vary by location or application. This problem will usually show up initially as the mixer motor jamming, or reversing by itself. It should be attended to before it damages the motor. If the mixer has any signs on damage or wear, it must be replaced.

Positive Electrode

While the sample cell is dismantled, check the positive probe (gold). The probe is 24 karat gold, and as such, it is inert. So normally, it will not require any cleaning, other than wiping with a cloth. The gold probe should never need replacement, unless it has been physically damaged. It is made of a 24k gold sleeve that is press-fitted onto a pure copper stub, which is sealed on either end. If the cap, the probe or the gold sleeve is loose the seal is broken. Once the seal is broken, sample water gets inside the probe and creates an electrical reaction within the probe, which show up as erratic readings or wandering calibration. Positive electrodes can only be repaired at the factory.

pH and Total Alkalinity

Check the pH and total alkalinity (TA) of the sample water. If the pH is above 7.5 or the TA is above 50 ppm, you cannot use the #13 peristaltic pump tubing, you must use the #14 tubing. If you are already using the #14 tubing, and have high pH (above 9.0) or high TA (above 150 ppm) or a combination of both, it may require a stronger 10% “pickling vinegar” or the KI peristaltic pump option. The pH in the sample cell should be around 4.0. If it is higher than 5.5, the analyzer will probably read sluggishly, or wander. To check for this, you can either take a pH reading of the water coming from the left drain, or just add a few extra drops of vinegar to the sample weir. If the residual reading goes up, there is a pH and/or TA problem. If the reading does not change, it is unlikely that you have a pH or TA problem.

Electrical Interference

Check for electrical interference. This might include close proximity to heavy electrical equipment such as: variable speed motor drives, cathodic protection systems, computers, radio transmitters, cellular phones, or walkie-talkies. Normally, electrical interference can be solved with good electrical grounding, but some cases may require a different location for the analyzer. Make sure that there isn't any interference from equipment located on the wall in the next room, behind the analyzer.

Electronics Failure

Electronics failure in the analyzer is rare, unless the unit has been hit by lightning, or experiences a power surge. The analyzer has gone through a live “wet-test,” before it leaves the factory, so there should not be any initial startup problems, other than general calibration to your sample water. All the trimmers used on the analyzer are 30-turns units, so it may take more adjustment than you think necessary to see a change in calibration. Electronic problems are often just improper calibration.

If it appears that there is an electrical problem on initial startup, check the ribbon cable for bent pins on the connectors. This usually happens when the top board is removed for wiring access, and the ribbon cable is hastily or carelessly reconnected after the wiring is done. If you have problems with the 4-20mA signal output, it is a good indication that there is a problem with the ribbon cable.

If you still suspect an electronics problem, try this test:

Remove the wires from the sample cell and use the ZERO trimmer as a chlorine residual simulator (you will have to recalibrate after this test). You should be able to run the analyzer up to the maximum value of its range (e.g., 0.00 - 5.00 ppm). Turn the ZERO trimmer counter-clockwise to increase. As you move through the range, the milliamp output should follow the readings, and the low and high alarms should activate at the levels they are set for. If you go to a negative reading, rather than positive, the milliamp output will drive to maximum value until you return to a positive reading (unless you have the anti-negative board option). If you leave it set at a specific value, such as 5.00, it should stay there. The reading should not change more than one digit (assuming that you have already ruled-out external electrical interference).

Std. Control

The Std. trimmer (VR-2) is wired in parallel with the coarse span trimmer (VR- 3). If either one is already at its minimum value, it will negatively affect the usable range of the other. If you are unsure of how low a trimmer is set, turn it in one direction until you feel a click (or 30 turns, if it does not click), and then turn back 15 full turns. This will put it at mid-range as a starting point for calibration. For more detail on calibration and re- ranging, see pages 22-24, and page 27.

Voltmeter Check

A digital voltmeter connected to TP-1 and TP-2 will allow you to check the voltage range of the analyzer. The usable range of the analyzer is always 0.00 - 5.00 volts DC, regardless of the calibrated range. Zero volts is always 0.00 ppm, and 5.00 is always the maximum “span” value of the analyzer. The factory default value is 5.00 ppm. If the analyzer was ordered with a different range, or the unit was re-ranged in the field, the span value on the display will differ.

ZERO Trimmer Problems

The ZERO trimmer has a full 30 turn adjustment range. It offsets the voltage of the input signal from the sample cell, so that a proper zero reading can be set. It has a range of -8.8 to +8.8 VDC, as measured with a digital voltmeter on test points TP-1 and TP-2. Turning the trimmer counter-clockwise increases the voltage, and clockwise decreases the voltage (this is exactly opposite of the Std. trimmer). The analyzer is never operated in the negative voltage range. If the ZERO trimmer is inadvertently set so that the circuit is operating in a negative voltage range, the resulting analyzer operation will be erratic or impossible to calibrate. A good indicator of this is when the reading goes negative following a chlorinated sample being fed to the analyzer and after having set the ZERO calibration. Another example is if the milliamp output goes to maximum when the LED display shows a negative number.

The best way to determine if the ZERO trimmer was set incorrectly, is to attach a digital voltmeter to TP-1 and TP-2, as the problem usually won't show properly on the LED display. If the voltmeter reading shows a negative voltage for any point in the normal analyzer range (factory set default is 0.00 to 5.00 ppm), then the zero setting is incorrect.

The best way to set the ZERO trimmer is to turn it fully counter- clockwise, until you hear a click once per revolution, or 30 full turns. This will max-out the display at about 5.50 ppm and show on the voltmeter at about 8.8 VDC. Then turn the trimmer clockwise until the reading falls to 0.00 on the display and/or voltmeter (this may take several turns).

9 Service

System Repair

Customer Service Department

9.1 If you need spare parts, assistance in troubleshooting, or repair service, please contact Foxcroft Customer Service at:

Foxcroft Equipment and Service, Co. Inc.
2101 Creek Road, P.O. Box 39
Glenmoore, PA 19343

Tel: (800) 874-0590
(610) 942-2888
Fax: (610) 942-2769
Email: service@foxcroft.com
www.foxcroft.com

9.2 Customer Repair / Returns Policy

All systems returned for repair or replacement must be freight prepaid and include the following information:

1. A clearly written description of the malfunction.
2. Name of person to contact and the phone number where they can be reached.
3. Proper return address for shipping system back. Include preferred shipping method.
4. A purchase order if the system is out of warranty to cover costs of repair.
5. A Return Material Authorization Number (RMA) is required before shipping any products for service. Call telephone number above to receive a RMA number.

NOTE: *Returns will only be held at Foxcroft for 90 days. If a decision is not made regarding the repair, the product will be returned.*

10 Product Warranty

Foxcroft Equipment & Service warrants all products obtained hereunder to be free from defects in material and workmanship for a period of one year from the date of shipment. In the event of a product failure or defect requiring warranty repair, the customer must obtain an RMA number by calling 1-800-874-0590, before returning the product, at the customer's expense to Foxcroft for repair. Warrantor (Foxcroft Equipment and Service) will repair the unit, without charges for parts, labor and return freight.

Foxcroft Equipment & Service is not responsible for damage to its products through improper installation, maintenance, act of God, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or for any unauthorized repair.

Buyer agrees to hold Foxcroft Equipment & Service harmless from all claims for damages arising out of injury or death to any person or damage to any facility, or any other property, or loss of use of any such property, whether such person or property is on or off the installation or activity site for which the equipment or material furnished hereunder is destined and whether such damage, loss destruction or loss of use, injury or death results directly or indirectly from a nuclear incident or for any other cause.

Statements and instructions set forth herein are based upon the best information and practices known to Foxcroft Equipment & Service but it should be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.



Serial Number Label of FX-1000p-B

Bufferless Amperometric Chlorine Residual Analyzer:

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