OPERATION AND
SERVICE GUIDE
O — 1300
DEC. 1982

ORP CONTROLLER

MODELS	PRICE CODE NUMBERS
443	56-0044 56-0044 A

Refer to Bulletin A-302

GENERAL INFORMATION

Model 443 ORP Controller is designed for addition of chlorine, sulfur dioxide or other oxidizing or reducing chemicals to water. An instrument for controlling chlorine or other oxidizing chemicals will have a 0 to +I000 millivolt scale. It may be identified by the word Chlorine on the power terminal strip inside the instrument. An instrument for controlling sulfur dioxide or other reducing chemicals will have a 0 to -1000 millivolt scale. It may be identified by the words Sulfur Dioxide on the power terminal strip. The only control on the front panel is a knob for adjusting the set point. The set point is the meter voltage at which power will be turned on or off at the power output receptacle. The controller will turn on power at the black receptacle in the bottom whenever the meter is below the set point. The light adjacent to the set point dial will turn on whenever power is on at this receptacle.

A complete installation will consist of an electrode to measure the ORP of the solution being monitored. In addition, there will be the controller and the neutralization system. This will consist of a tank to hold the oxidizer or reducer. Flow will be controlled by a valve or pump. This chemical will be mixed with the material being controlled. The mixing is usually done in a tank or pit with thorough stirring. The electrode measures the ORP of this mixing tank.

The instrument is housed in an aluminum case with all of the controls on the front panel. The meter at the top indicates the oxidation-reduction potential of the solution being controlled. One (or two) knobs labeled ORP set the ORP at which the control relay will operate. Electrode connections are on the bottom of the cabinet cover. Power connections are on a terminal strip inside the case.

The dual controller option has several uses. This second control point may be used for an over range alarm. If solution being controlled may swing both plus and minus, two separate neutralization solutions may be added to control the ORP within a selected range. As an alternative, the two-limit controller can be used to add chemicals at two different rates which will provide a degree of proportional control. The latter arrangement is valuable when there are large fluctuations in the amount of material to be neutralized. If this option is used with a pump which has a reversible motor driven rate control, a very wide range of neutralization solution addition rates can be accomplished while maintaining the pH in a narrow range.

The instrument itself consumes 20 watts of 115 volts AC power. It will operate reliably over a range of 100 to 130 volts. The maximum load is 5 amps resistive or a 1/6 HP motor.

INSTALLATION

The controller may be mounted in any position. For panel mounting make a cutout of 12-1/8" by 8-1/8". Wall mounting is done by drilling holes in the rear of the cover. To install the instrument, first remove the rear cover. It is retained by the four binding head screws located near the top and bottom of the front panel. After removing the screws the cover can be lifted over the interior parts. The front panel with the electronics can be completely removed from the cower by removing the two retaining screws for the electrode connectors and loosening the screws for the internal strips.

If power is to be brought in through a conduit, remove the power cord. At the left end of the terminal block there are two sets of terminals marked COMM and PUMP. These are the output terminals from the relay. If the instrument has two set point control knobs, the right knob controls the right set of COMM and PUMP terminals, and the left knob controls the left sat of COMM and PUMP terminals. Connect the control valve or pump to the COMM and PUMP terminals.

In some applications it may be desirable to have a switch between the controller and the pump or valve. This should be added during the installation if there may be a need to obtain a ORP reading without the controller operating the pump or valve adding neutralization material.

Select the optimum position for monitoring the solution ORP. This will be the electrode location. If a tank is being controlled, the electrode location must be typical of the composition of the entire tank. If a stream is being controlled, all of the stream or representative portion of the stream must flow past the electrode. Successful ORP control will require adequate mixing of the solution before it reaches the electrode. The additional point for neutralization solution must be selected to provide such mixing before the solution reaches the electrode. For a tank it is generally necessary to have a propeller type mixer or a circulating pump. The maximum rate at which neutralization material can be added will depend on the speed of mixing.

Mount the electrode so it will always have the junction for the reference as well as the platinum electrode under the solution surface at all times. Excessive neutralization material may be injected if the electrodes are out of the solution and can not present the correct signal to the controller. Support for the electrode should be arranged so the electrodes may be easily removed for cleaning. Since the electrode cable is only 30 inches in length, an extension cable is usually required. Make certain the electrode connector cannot became grounded or the ORP reading will not be correct. This connector is at a slightly different voltage from ground due to the voltage generated by the reference electrode. BNC to BNC Extension Cable is available in any length to 100 ft. which is the maximum recommended. If constructed by the user, the cable should be of RC-174/U type. If there is a separate reference electrode in the system a Pin Jack to Pin Plug Cable is available.

Neutralization solution may be supplied from a pump or gravity fed from a tank through a solenoid valve. In either case it should be possible to regulate the flow if precise control of ORP is desired. Many different types of metering pumps are available which have adjustable stroke length, period between strokes or motor speed. If gravity feed is used, a needle valve should be near the solenoid valve to control the flow rate. Adjustable rate solids feeders are available from several manufacturers. If the pump or feed mechanism requires more power than this instrument is capable of handling, a heavy duty electrical contactor will be required.

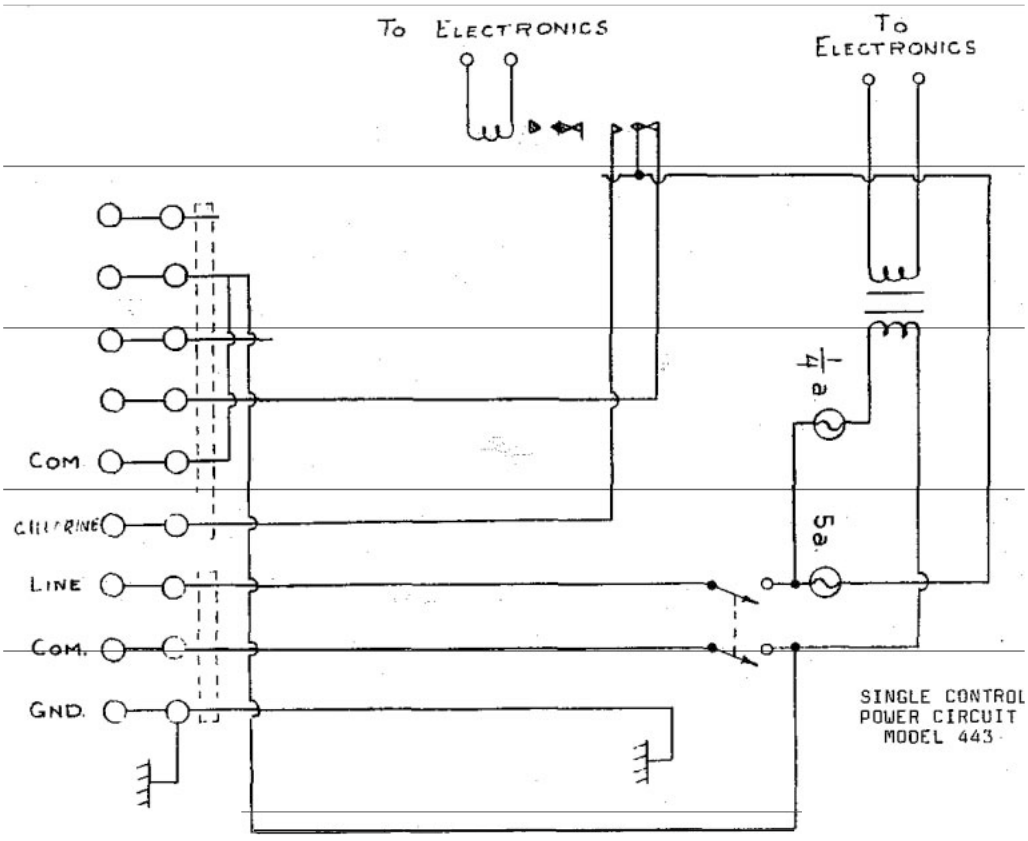
ELECTRODES

Oxidation reduction potential (ORP) is detected with a platinum electrode. The voltage of the platinum electrode is measured against a reference electrode to complete the electrical circuit. These two electrodes may be separate or mechanically housed together as a combination electrode. When a combination electrode is used, the connecting cable braided shield is connected to the reference electrode. The cable central wire is connected to the platinum electrode. If separate electrodes are used, the platinum electrode is connected to the BNC and the reference electrode is connected to the pin jack adjacent to the BNC.

REFERENCE ELECTRODES

Inside there is a silver wire coated with silver chloride. This wire is connected to the cable. The interior of the electrode is filled with potassium chloride solution saturated with silver chloride. Electrical connection between the interior and exterior of the electrode is through a fine ceramic junction. Flow of solution through the junction is less than 8 micro liters per hour.

The reference electrode may be sealed or vented. If sealed, it may have a replaceable junction and filling solution. A vented electrode will require periodic filling with solution. Make certain the. correct solution is used for this type of electrode. A sealed electrode, which cannot be filled, will have a finite lifetime. The life will depend on the amount of sample entering and leaving the electrode. This sample breathing process will be affected by temperature and pressure changes. The life may be a few months to a few years with longer life obtained with less solution breath-



ing. A sealed electrode with a replaceable junction may be refilled with potassium chloride crystals and solution.

It is extremely important that the reference electrode junction be clean and free of any deposit which might block the flow of internal solution. A fouled junction is the most common source of erratic signal. The junction may be cleaned with a paper towel. For industrial type electrodes which have the junction in plastic, the junction may be sanded or filed. Sometimes a cleaning chemical such as hydrochloric acid may be required.

MAINTENANCE

At weekly intervals the filling solution level of a refillable reference electrode should be checked. If a flow or immersion assembly is being used, the filling solution level need be checked only once a month. If the sample is oily, or has a large amount of suspended solids, the glass pH bulb and the junction should be thoroughly wiped with a wet paper towel. If the relay contacts become worn, it should be replaced. The relay is a standard type available from several manufacturers. A replacement unit should have a 12 volt coil with at least 75 ohms resistance. If the ORP set point control knob is removed, it should be returned to a position so its calibration matches the meter. With the instrument turned on, turn the knob until the relay turns on (pump or valve operates). Without turning the knob shaft, loosen the knob set screw and fasten the knob in place with the pointer at the pH on the meter. Refer to Serfilco Product Catalog and Bulletin P-607 for Metering Pumps.

TROUBLE SHOOTING ORP INSTRUMENTATION . . & CONTROLS

ISOLATE THE PROBLEM TO:

1. The instrument
2. The electrode
3. The extension cable of the electrode installation

I. ISOLATE THE PROBLEM

A. Using a known voltage source or instrument calibrator, apply 200, 400, 600, 800 mv and watch the instrument track the input voltage.
    1. In some instruments the calibration control can offset the millivolt readings. With these instruments it will be necessary to short the input to the instrument and than, by using the calibration control, zero the pointer or display before applying the test voltages.
    2. With instruments that have full upscale plus or minus display. be sure that the polarity of the input signal is the same as the for upscale readings.
    3. With instruments that have a zero center mv scale, movement to the left or downscale is plus and movement upscale or to the right is minus.
    4. It is possible to use a pH calibrator to check ORP instrumentation. Be sure that you convert the pH scale into the millivolt levels. There are 59 mv per pH so that pH 5 will be +118 mv and pH.9 will be -118 mv, pH 7 is zero millivolts.
    5. If a known voltage source or instrument calibrator is not available, pH electrodes can be used to provide known voltages t o check out an ORP instrument.
        a. A good pH electrode will put out about +177 mv when immersed into pH. 4.00 buffer solution.
        b. A good pH electrode will put out about -177 mv when immersed in to pH 10.00 buffer solution.
        c. A pH electrode will show some millivolt output in pH 7.00 buffer, but the actual voltage amount and whether it is plus or minus will depend upon the manufacturer of the electrode .
    6. If the pointer doesn't move:
    a. Check the wires to the meter for a short or loose connection.
    b. If possible, move the instrument to see if the pointer is mechanically jammed.
        1. If the pointer is stuck, remove the meter and then remove the cover. The meter mechanical zero adjust may have broken and jammed the movement. Check and carefully remove any obstruction.
        2. To calibrate an instrument that doesn't have a mechanical zero adjust, turn the instrument on and mechanically zero the pointer. Then replace the cover. This will compensate for any off set in the input amplifier and further adjustment should not be required
        3. If the meter drifts, is erratic, or is full upscale or downscale with the voltage source attached, the electronics may need service. Consult factory.

B. Set the indicator to +350 mv or any other convenient point
    1. Rotate the set point knob through the indicated value. There should be relay actuation and the lamp should go on or off. Power at the out put terminals should also go on or off.
    2. Newer instruments have a switch on the set point circuit board to select relay operation above or below the point. These instruments have outputs labeled line and common.
    3. On older instruments the relay and lamp will go on only above the set point. These instruments have outputs labeled acid, common and alkaline. There will be power between one terminal and common when the lamp is off and the other terminal and common when the lamp is on.
    4 Some instruments are wired for contact closure only and generally control low voltage installations. . With an ohmmeter, they will indicate open and closed positions but no voltage.

II. ELECTRODES . . - .-

A. Plug the electrode into the instrument.
B. Rinse the electrode with distilled water.
C. Add Quinhydrone to pH 7.00 and 4.01 buffer solu-

tions. Approximately .4g will saturate 50 to 100 ml of buffer.

1. In pH4.01buffer,the electrode should read between + 250 and + 300 millivolts.
2. In pH7.00 buffer, the electrode should read between + 8O and + I20 millivolts.

D. If the electrode reads a difference of 170 mv between the value in the pH 7.00 buffer and the value in the pH 4.01 buffer, but the readings are above or below the values above, the reference junction is contaminated and/or the filling solution should be replaced.

E. If the electrode will not produce a reading:
   1. The electrode or cable is shorted and should be replaced.
   2. The reference or filling solution is contaminated or gone and needs to be replaced.

F. If the electrode response is slow:
   1. The metal ORP sensitive ring, pin or disc may be contaminated and needs to be cleaned. The ring, pin or disc should shine. If there is a hazy or foggy surface, use an on abrasive cleaner, such as B on A mi, and polish the surface.
   2. If the ring, pin or disc is rust or golden colored, there may be copper or other metal in the solution that is depositing on to the electrode. The source of the materiel should be determined and removed, if possible. The electrode can be cleaned with mild nitric acid, polished, and retested.

III. EXTENSION CABLES 6 ELECTRODE INSTALLATION

A. Check the extension cable for failure
   1. There should be more than 100 megohms between the BNC shell and instrument and solution around. If not. then the BNC shell has become arounded.
   2. The cable-is shorted if there is less than 100 megohms between the center conductor and the shell of the BNC connector.
      a. If a high resistance short is found, it may be caused by moisture in the BNC. Clean with alcohol and retest.
      b. A low resistance short is caused by the shield coming in contact with the center conductor of the cable. In this case, replace the cable.
   3. Check to see if the cable is open.
      a. There should be continuity between the shell at one end and the shell at the other. If not, the cable should be replaced.
      b. There should be continuity between the center contacts at both ends of the cable. If not, the cable should be replaced.

B. Check for correct electrode installation.
   1. The electrode should be deep enough into the solution so that both the reference and the platinum are submerged.
   2. The electrode should be close to vertical with the ORP sensing end down.
   3. The BNC connector should be insulated from any electrical ground potential.
   4. In some installations the sample solution will have to be grounded in order to have accurate readings, and normal electrode life.

IV. OTHER FAILURE CONDITIONS

A. If the instrument reacts when a solenoid or valve turns on or off:
   1. Check for improper grounding o f the instrument or solution.
   2. Check for low voltage to the instrument which may cause the instrument to fall out of regulation.

B. If ORP measurements are not stable or the controller is unable to stabilize the sample:
   1. Check for insufficient mixing of the sample.
   2. Make certain the electrode and the feeder are not too close together or too far apart.

C. If the instrument is calling for feed and there is no indication of ORP change:
   1. Make sure there are chemicals in the supply tank.
   2. The feed solenoid may be frozen or jammed in the closed position.
   3. There may be lack of agitation in the mixing tank, or loss of sample flow past the electrode.
   4. The fuse may be blown at the instrument and there is no voltage to the feeder.
   5. The override switch on the instrument may be in the “OFF” position.

D. If the instrument is not calling for feed and the ORP is changing:
   1. The solenoid or valve may be stuck in the open position.
   2. The instrument relay may be stuck in the “ON” position.

F. If the instrument calibrates correctly in buffers but will not read correctly in the sample, the BNC may have become grounded in the electrode system.

SERFILCO®, LTD.
2900 MacArthur Blvd.
Northbrook, IL 60062-2005 U.S.A.
e-mail: sales@serfilco.com
847-509-2900
800-323-5431
FAX: 847-559-1995
www.serfilco.com