Model 435A
pH Monitor/Recorder
Manual

A digital version of this manual is available online at www.krugerandeckels.com

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Description

Model 435A Weatherproof Recording Monitor is designed to continuously monitor and record the pH of solution. A complete system will require an electrode and possibly an extension cable. Accessories are available for various applications.

The instrument has a power switch, fuse, electrode calibration, and temperature compensation on the front panel. A sliding access window permits adding notes to the chart. The recorder swings down to replace the chart paper. Electrode connection is at the rear interior.

The recorder requires 10 watts of 115 volts AC power. It will operate reliably over the range of 100 to 130 volts.

The front panel may be removed from the enclosure by removing the left front panel and interior lower corner screws.

The electronics are high quality solid state, and should provide trouble-free operation. The input impedance is the same as in our laboratory instruments; 1 pico amp nominal and enables the installation of almost any electrochemical sensor. Cable runs of 100 feet are possible without signal deterioration.

Operation

Connect the electrode and calibrate the instrument. Use two buffers to insure that the electrode is responding properly. Put the electrode in the first buffer and adjust the calibration knob so that the instrument reads the same pH as the buffer value. Remove the electrode, rinse it off with water and put the electrode into the second buffer solution. The instrument should read the value of the second buffer without further adjustment. Insert the electrode into the sample. The temperature knob should be set at the temperature of the sample.

Electrode calibration should be performed on start up. The calibration procedure should be repeated periodically. The frequency of recalibration will be determined by electrode type, sample composition and other factors. After start up, the calibration should be checked and a periodic electrode cleaning and standardization schedule should be established.

Electrodes

There are several types of electrodes available for controllers and recorders. A combination electrode is generally ordered with the instrument. A combination electrode has both a glass pH sensitive electrode and a reference electrode in one unit. Separate glass and reference electrodes are for special applications such as high pressure, temperature or unusual chemistries.

The glass pH electrode produces an output voltage potential dependent on the pH of the solution on the outside of the glass bulb. The pH sensitive portion is a thin glass membrane with a spherical surface on the end of the electrode. Inside this bulb is a silver wire coated with silver chloride and a buffer solution. The amount of voltage potential produced depends on the pH and is influenced by temperature. The pH potential is measured across the glass membrane which constitutes a high resistance in the order of 20 to 200 megohms.

Electrode Temperature

The pH calibration of all glass electrodes is dependent on temperature. Therefore, it is necessary to compensate for temperature of the electrode. A Temperature control knob is on the front panel for this compensation. For measurements within one pH of the buffer and between 10C and 40C, the temperature correction error is below 0.1 pH. Consequently, for this type of measurement, the temperature control may be left at 25 C. For measurements at greater than one pH from the buffer and requiring accurate results, the temperature knob must be adjusted. Set this knob to the temperature of the buffer when standardizing the electrode.

For best accuracy, the buffer temperature and the sample temperature must be the same. One method of accomplishing for field work is to immerse the bottle of buffer in the sample solution for a few minutes.

All glass electrodes have a temperature co-efficient proportional to the absolute temperature. The voltage produced by the electrode is greater at higher temperatures. For example, if an electrode is calibrated with buffer at pH 7.00 and a temperature of 25 C, each one pH change will produce an output change of 59 millivolts. At 50 C, each one pH change will produce an electrode output change of 64 millivolts. The meter Temperature knob adjusts the number of millivolts change at the input connector required to make a one pH change on meter. The instrument temperature compensation knob is essentially a slope control or in electronic terms, an amplifier gain control.

It is essential that the electrodes be periodically calibrated. The frequency will depend on the amount of oil and suspended solids and the chemistry of the water being controlled. Satisfactory electrode performance is dependent on good electrical contact between the electrode and the water. Accumulated deposits on the electrode surface can interfere with response to pH. One of the electrode calibration procedures described in this manual under OPERATION should be used. For a new system at first this should be daily. If it is found the calibration drift is insignificant, the period between calibration tests may be extended.

Electrode Cleaning

Soap and water will remove oil and grease but will not remove scale or calcification. Hydrochloric acid will remove scale and calcium deposits but it will not remove oil and grease. In order to properly clean an electrode the nature of the contaminant should be identified, and a proper cleaner found. Soap and water and a small tooth brush will remove many common contaminants.

It should be noted that many soaps, commercial cleaners, glass cleaners, contain chemicals that will leave a electrically conductive film on the pH sensor, and interfere with the measurement. When inspecting the electrode for contamination, check the electrode when it is dry. Liquid on the electrode will make the glass or platinum surface glossy and hide scale. Hard water can cause scale on the electrode. Dry patches on a wet electrode may indicate oil or grease contamination.

Electrode Storage

When pH and ORP electrodes are not in use they should be stored in 3.8 M KCl or saturated KCl. Sometimes the electrodes come with a protective plastic cap on the pH bulb, and this can be filled and used for storage. If the electrodes are stored dry the filling solution will slowly wick out of the electrode. This is not a problem with refillable electrodes, but will reduce the effective lifetime of non-refillable electrodes. Storing the electrode dry will also affect the pH sensitive glass bulb which will dehydrate, and need to be soaked in KCl before being used for measurement.

Do not store pH electrodes in distilled or deionized water, as it will leach out the filling solution. Distilled and deionized water can cause crystals to form inside the reference junction. A good storage solution is 3.8M potassium chloride or saturated potassium chloride. Reorder #81966

Buffer Solution

Buffer solutions for calibrating the electrode are available from your pH meter dealer, or may be prepared from the instructions provided in many chemical handbooks. For best test accuracy, the buffer pH should be as close as possible to the sample pH. Buffer solution pH may change with time due to absorption of carbon dioxide. Solution stored in plastic bottles for more than a year should be suspect and checked against fresh buffer. Deterioration is greatest for high pH buffer, such as borate.

All buffer solutions change pH with a change in temperature.

The pH of buffer solutions available from your dealer is shown below:

Temperature	4.00 pH Buffer	7.00 pH Buffer	10.00 pH Buffer
0	4.00	7.12	10.31
10	4.00	7.06	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.00	7.00	10.00
30	4.01	6.99	9.95
35	4.02	6.98	9.91
40	4.03	6.97	9.87
50	4.06	6.97	9.81

Sample pH will also change with temperature depending on the composition. For accurate results, it is important that buffer and sample be at the same temperature. Conversely, if an accuracy of only 0.2 pH is required, buffer pH drift with temperature generally may be ignored.

Troubleshooting Instrumentation

Isolate the problem to:

1. The instrument
2. The electrode
3. The extension cable

Instrument Checkout

1. Short the input with a shorting strap, shunt or a paper clip. Connect the center conductor to the shell of the BNC.
    a. The instrument should span from pH 0 to 14 when the calibration knob is turned from full left to full right.
    b. Some instruments will have a 10 turn calibration knob and will span from 0 to 14 pH.
    c. If the instrument is offset for antimony electrodes, the span will be below 0 to 4 or 5 pH.
    d. Adjust the calibration knob to read pH 9 and turn the temperature knob from OC to 100C. The reading should change almost a full pH unit
    e. If the pointer doesn't move:
        i. Check the wires to the meter for a short or a loose connection.
        ii. If possible, move the instrument to see if the pointer will move. If the pointer is stuck, remove the meter and remove the cover. Carefully check and remove the obstruction. The meter zero adjust may have been broken and jammed the movement; the mechanical zero adjust is not necessary in most pH measurements.
    f. If the meter drifts, is erratic or is full upscale or downscale with the BNC shorted, the electronics may need service. Consult your dealer or the factory.
2. Set the indicator to pH 7 with the calibration knob.
    a. Rotate the set point knob through the indicator value. There should be relay actuation and the lamp should go on or off. Power at the output terminals should also go on or off.
    b. On some instruments the set point lamp will go on only above the set point. In these instruments there are separate output connections for alkaline and acid feeders.
    c. Newer instruments have a switch on the set point circuit board to select for above or below set point operation. These controllers have outputs labeled line and common.
    d. Some instruments are wired for a contact closure only. These will show an open or closed measurement with an ohmmeter.
    e. Series wired set points (Inter-wired set points)
        i. In this case a second set point will also have an effect on set point output. The most common case is that the first set point has to be on and the over-range safety set point has to be on.

ii. With the first set point on, rotate the second set point to see if it will control the output. Generally, the second set point will interrupt feed if the pH goes above the second set point.

Electrode Checkout

1. Plug the electrode directly into the instrument.
2. Rinse the electrode with distilled water; some meter movement is normal during washing.
3. Put the electrode into pH 7 buffer solution, allow the electrode to stabilize and adjust the calibration knob to make the instrument read 7.00.
4. Remove the electrode, rinse, and put the electrode into pH 4.01 buffer. The electrode should read the buffer value in the first few minutes. Repeat the above with pH 10.00 buffer.
    a. If the electrode will not produce a reading:
        i. The electrode is shorted and needs to be replaced.
        ii. The reference solution is contaminated or gone and needs to be replaced.
    b. If the electrode will not read the buffer values and/or is slow in response:
        i. The pH bulb is contaminated and needs to be cleaned. A fingerprint is enough to cause incorrect readings.
        ii. The reference junction is clogged or the reference solution is contaminated.
            1. Sealed electrodes can temperature-cycled in a 2 molar KC1 solution which may clear the obstruction.
            2. Refillable electrodes can be recharged and the reference junction can be replaced. Consult the dealer or manufacturer.
        iii. Compressed response is an indication that the electrode is aging or needs service. As a temporary measure the temperature knob can be used to amplify the electrode output, or the slope control can be used for compensation.

Extension Cables and Electrode Installation

1. Extension cable failure
    a. The BNC shell has become grounded. There should be more than 100 megohms between the BNC shell and instrument and solution ground.
    b. The cable is shorted
        i. There should be more than 100 megohms between the center conductor and the shell of the BNC connector. If a high resistance short is found, it may be caused by moisture in the BNC. Clean with alcohol and retest.
        ii. 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.
    c. The cable is open and should be replaced.
        i. There should be continuity between the shell at one end and the shell at the other.
        ii. There should be continuity between the center contacts at both ends of the cable.
2. Electrode Installation

a. The electrode should be deep enough into the solution so that both the reference and the glass bulb are submerged.
b. The electrode should be close to vertical with the pH bulb down.
c. The BNC connector should be insulated from any electrical ground potential.
d. In some installations the sample solution will have to be grounded in order to have accurate readings, and normal electrode life.

Other Failure Conditions

1. The instrument reacts when a solenoid or valve turns on or off.
    a. Improper grounding of the instrument or solution.
    b. Low voltage to the instrument, causing the instrument to fall out of regulation.
2. pH measurements are not stable or controller is unable to stabilize the sample.
    a. Insufficient mixing of the sample.
    b. The electrode and the neutralizer feeder are too close together or too far apart.
3. Instrument calling for feed and no indication of pH Change.
    a. Lack of neutralizer in the supply tank.
    b. Failure of the feed solenoid to open; frozen or jammed.
    c. Lack of agitation in the neutralization tank, or loss of sample flow past the electrode.
    d. Fuse blown at the instrument, and no voltage to the feeder.
    e. Override switch on the instrument in the off position.
4. Instrument not calling for feed and pH changing.
    a. Solenoid or valve stuck in the open position.
    b. Instrument relay stuck in the on position.
5. Instrument calibrates correctly in buffers but will not read pH correctly in the sample.
    a. The BNC has become grounded in the electrode system.

Warranty

Kruger & Eckels, Inc. warrants all of its electronic instrumentation for two years against defects in material or workmanship. This warranty does not apply to mechanical meters, recorders or electrodes, which are covered by separate warranties by their own manufacturers. Should a failure occur, the unit will be repaired at no charge to the customer.

Mechanical meters and recorders are warranted for one year, and electrodes are warranted for six months. This warranty covers normal use and does not cover damage which occurs in shipping or failure which results from accident, abuse, improper installation, improper maintenance, or using the device in a manner which is not recommended by Kruger & Eckels.

Replacement Parts

Part Name	Part Number
Replacement recorder	35700
¼ amp fuses (Box of 5)	38504
Digital display	81590

Maintenance Accessories

Part Name	Part Number
Sensor storage solution	81966
Buffer solution 4.00 pH	81968
Buffer solution 7.00 pH	81969
Buffer solution 10.00 pH	81970