

894 pH CONTROLLER OPERATING PROCEDURE

OBJECTIVE:

The 894 pH Controller does two jobs:

1. Automatically adjusts the pH of a solution to maintain a predetermined and set Range of pH. (i.e.: 4.0 - 4.5 pH).
2. Equipped with a feed pump to maintain chemical concentration at a predetermined rate of feed. (% of concentration is not controlled due to the variable consumption of chemical in the solution by the different types of parts going through the wash at different times in the phosphate stage).

The 894 pH Controller is used in our washes because precise and accurate monitoring of pH levels is very critical.

THEORY OF OPERATION:

The operation of 894 pH controller is divided into two separate feed pumps.

pH Adjust Feed Pump

The pH adjust feed pump is controlled based on the range or window of acceptable pH levels for a given solution. This range is controlled by the "hi" and "low" pH dials inside the controllers. If the pH level goes out of the set range a pH indicator light will come on and the system will begin pumping the appropriate adjusting chemical to adjust the pH. If the system does not correct the problem within a set time frame (adjustable using the low chemical timer) then the flashing light accompanied by an audible alarm will go off. This alarm is set to go off only if the pH stays above the acceptable range for a specified length of time. The amount and speed that the adjusting chemical is added is controlled by an on/off timer (the pump is on for "x" seconds then off for "y" seconds).

Concentration Feed Pump

This pump simply pumps phosphate chemical into the solution at a predetermined rate regardless of the concentration of the solution. The rate of flow is determined by an on/off timer. The pump is on for "x" number of seconds then off for "y" number of seconds. The on/off time will require adjusting in order to maintain the appropriate concentration. Under normal circumstances the off time should remain set at a specific time frame and only the on time adjusted. This provides a standard in order to determine the quantity of chemical being pumped. **Except for extreme circumstances the rate of chemical feed is to be adjusted using the timer rather than bypassing the timer by finding an alternate source of power. (Usually changing the on time by a couple of seconds will balance the solution). i.e.: If the phosphate solution is too low it is recommended that you turn up the on timer a few seconds. (2-3 seconds is usually good). Monitor the batch closely after making any adjustments.**

MAINTENANCE AND CALIBRATION

Maintenance of the 894 is very important because of the pH range. Careful monitoring of the pH readings is essential. The reading must be double checked with a calibrated manual pH meter every shift. This is called a grab sample verification. The grab sample must be taken from the valve on the same circulation line as the pH probe. When this is not possible a large enough process sample should be taken and both probes submerged in the one process sample either at the same time or one immediately after the other. It is critical to take the readings close together. If the difference between the two readings is .2 adjust the 894 as per grab sample calibration procedure.

Feed pump hoses should be visually inspected for wear and cracking.

The pH probe should be **cleaned** and then verified for calibration every week.

Turn off circulating pump probe solution feed valve and the return line valve. This shuts off any solution flow to the pH probe.

Unplug the feed pumps and if the wash is shut off find an alternate power source for the controller.

Remove probe by unscrewing the fitting on the probe and pulling the probe out. Some solution will drain out.

Inspect the O-ring on the probe. Replace if worn out or damaged.

If the probe has been just pulled out of process it must be cooled down to ambient temperatures. Submerge probe in a container of water until ambient temperatures is attained.

Inspect condition of the probe by allowing the glass bulb to dry. A good clean bulb is clear with no hazy look to it at all. In order to determine this the bulb must be dry! A wet bulb may look clean but it is not clean. If the bulb is hazy initiate the following cleaning steps.

1. Wipe the outside of the probe clean using a soft towel or cloth. Do not touch the glass bulb, yet!
2. Submerge bottom (1" minimum) of the probe in a hydrochloric acid solution (ratio of 1 parts HCL: 5 parts water) for approximately 2 - 5 minutes.
3. Remove probe from HCL and rinse it really good with water to neutralize and rinse the HCL off the probe.
4. Allow probe to air dry and inspect for scaling. If it is still hazy repeat steps 2, 3, 4. If any oils etc. are evident a soft cloth soaked in solvent and gently wiped over the bulb should remove them. This must be followed by a through cleaning using a commercial glass or lens cleaner.

Note: If the glass still is not clean increase the ratio to a maximum of 1:1. This should be used as a last resort. Gentle wiping with a soft cloth can also be tried in difficult situations.

If the probe still is not clean the surface is likely abraded and if the response time is also slow a new probe should be installed. (See "New probe" section).

Revive the probe.

Note: This must be done every time a probe is going to be verified using buffers. It makes the probe aware of its surroundings.

Rinsed liberally with distilled water - a good bath.

Place it in a buffer of 7 and stir it, let it soak for at least one minute.

Take it out and rinse liberally again.

Place it in a buffer of 4 and stir it, let it soak for at least one minute.

Rinse it liberally one more time.

DO NOT MAKE ANY ADJUSTMENTS TO THE CALIBRATION YET!

Field Buffer Calibration.

Verify the calibration by:

1. Place the probe in a buffer of 4 and stir for 5 seconds and then let sit.
DO NOT TOUCH THE CABLE AS THIS WILL DISTURB IT!
2. Note the response time. It should jump quickly to the general range and then slow down as it stabilizes.
3. Allow the reading to stabilize. If it is out by more than .05 adjust the display to 4.00 (\pm .02) using the input zero calibration potentiometer.

This requires removing the 4 screws around the display and carefully holding the display in one hand while adjusting the input zero with the other. The display is very sensitive and should be held steady in order to be accurate.

4. Quickly rinse the probe with distilled water.
5. Place the probe in a buffer of 7 and stir for 5 seconds, let it sit.
6. Note the response time as previous.
7. Allow the reading to stabilize. If the display reads:
 - Above 6.5 - the probe is fine. Go to **Grab Sample Calibration**
 - Below 6.5 - wait a couple more minutes and check it again - try stirring the probe in the buffer.

If the reading is stable, but below 6.7 and above 6.2 it probably needs more cleaning. Try again. If after a second cleaning the reading is below 6.5, but above 6.2 you can make up the difference using the input span (efficiency potentiometer).

WARNING IF THE INPUT SPAN IS ADJUSTED IT MAY COME BACK TO HAUNT YOU - YOU MUST RE-VERIFY THE CALIBRATION AS INPUT ZERO IS PROBABLY NOW MESSED UP!

If you still can not get a good reading with a buffer of 7 let it alone and proceed to grab sample calibration. If the grab sample is accurate, use the probe, buffers do not always work outside laboratories. If you can not make up the difference between the probe and grab sample (using input zero). Return the probe to systems operators and get a new one (see bench calibration for a new probe).
Grab Sample Calibration

Note: Never consider an 894 probe calibrated without doing a grab sample calibration. You must do this if accuracy and repeatability are desired. Depending on the probe and solution that it lives in it may not respond well to buffers due to the potential for buffer contamination and reactions between chemicals in the process, sensors and the buffers.

THE GRAB SAMPLE IS THE ULTIMATE AUTHORITY!

This calibration must take place at process temperature. If the grab sample is unstable (i.e.: pH reading will not stabilize) or is allowed to cool down it should be discarded and a new sample used. Take a large sample - it will be more temperature stable.

An accurate hand held pH meter with a temperature compensation is required ensure that this meter is calibrated and verified accurately.

Before proceeding with the grab sample calibration the probe should be put back into its proper home where it normally takes process readings. (Apply some Vaseline to the threads to prevent seize up).

Hand tighten probe only - DO NOT USE A PIPE WRENCH!

1. Take a process sample right beside the 894 probe (preferably using the valve that the probe is hooked up to).
Note the reading on the 894 controller when the sample is taken.
2. Immediately measure the pH of the sample using the handheld pH meter.
3. Subtract this reading from the 894 reading. Adjust the 894 (input zero) to make up the difference between the two readings.
DO NOT MAKE ANY OTHER ADJUSTMENTS.

If for some unknown reason this needs verification (remember some probes do not like buffers) you must start all over again with "Reviving the probe".

The reason for subtracting the difference rather than just adjusting the 894 to the handheld pH meter reading is:

- This is a zero or offset adjustment. They are made to a difference.
- The pH in the 894 controller or the temperature of the grab sample has possibly changed in the meantime therefore an adjustment made to match the two readings may not be accurate.

Note: If it is not possible to take a process sample from the 894 probe area after it has been put back then remove the 894 probe from its home and immerse both probes in a large process sample at the same time and compare readings.

Calibration complete. Be sure to return power to the feed pumps. (Do not mix up the chemical feed with the adjustor feed!!!)

GENERAL NOTES:

- 894 sensor probe tip should be kept moist at all times. Unnecessary drying of the probe tip will increase the sensor response time as well as reduce the life of the probe. This can be ensured by closing the **bottom valve first** and then the top valve.
- **CAUTION:** Calibration of a field sensor (probe already in service) in buffers may cause the process pH measurement to be incorrect by up to 0.4 pH. A field buffer calibration must be followed by a grab sample calibration.
- When using buffers minimize contamination by shaking water droplets off probe before inserting it in a buffer and ensure that all areas of the probe that will be in the buffers are clean. If the buffers turn cloudy after the probe has been in it or a precipitate forms them either your probe is not clean or there is a huge incompatibility between the probe and the buffers. Discard the buffers, reclean the probe and try again. If the same problem occurs then a buffer calibration is impossible - relay on the grab sample calibration.

NEW PROBE - BENCH CALIBRATION

Unwrap the sensor. If the probe tip is dry soak the sensor in a breaker of buffer or salt solution for a couple of hours before proceeding.

1. Connect the pH sensor to the analyzer including the temperature compensator connection.
2. Place the probe in a pH buffer of 7, stir and then let it sit for 1 minute minimum.
3. Take the probe out and rinse it off using distilled water.
4. Place the probe in a pH buffer of 4, stir and let it sit for one minute minimum.
5. Take the probe out and rinse it off using distilled water.
6. Place the sensor back in the 4 pH buffer. Stir with the buffer for 10 - 15 seconds - let it sit for 1 minute. Do not touch sensor cable. When it stabilized adjust the display using input zero to 4.00 ($\pm .02$).
7. Remove the sensor from the 4 buffer and liberally rinse probe in distilled water.

8. Place the sensor in a pH buffer of 7. Stir with the buffer for 10 - 15 seconds - let I ADJUST ANYTHING - IT IS GOOD. If it is outside 0.15 of 7 pH adjust the display to 7.0 using input span (± 0.02).
9. Recheck is desired. Make no adjustments if readings are within 0.08 pH of the buffer value.
10. Proceed to grab sample calibration. You must DO THIS IF ACCURACY AND REPEATABILITY ARE EXPECTED!

TROUBLE SHOOTING

1. Display read out will not stabilize.
 - Inspect all wires and connections for defects and moisture.
 - Initiate calibration procedure.
2. Alarm goes off.
 - Ensure feed pumps are connected.
 - Ensure chemical totes and barrels are not empty.
 - Check parameter settings.