



# PIE CALIBRATORS

## Troubleshooting pH Instruments

### **PIE Calibrators help you troubleshoot & calibrate pH Instruments**

Instruments that measure pH are some of the most difficult devices to maintain in a process plant. While temperature, frequency & pressure sensors, under the right conditions, measure for years, the pH sensors require regular maintenance and replacement. Many technicians get frustrated when there is a problem with pH sensors and instruments not reading correctly. A PIE calibrator with pH simulation can speed up the troubleshooting and adjustment of pH transmitters and analyzers. This is the most accurate method of checking the performance and gives you confidence that the instrument is working properly.

#### **Why pH instruments require regular probe calibration**

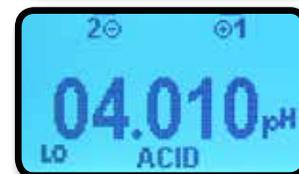
A typical pH probe is fragile and subject to damage from rough handling, thermal shock, dirt, and contamination. In addition the chemistry inside the probe shifts with time and is accelerated at higher temperatures. All these factors cause the output to shift and these shifts must be compensated through adjustments of two parameters to achieve the desired measurement accuracy. The first factor is OFFSET. A perfect pH probe will produce 0.00 mV when measuring 7.0 pH (deionized water). Even brand new probes will typically have a few mV of OFFSET. The other factor is SLOPE. SLOPE is determined by dividing the mV difference by the change in pH units. The theoretical slope is 59.16 mV. Some instruments indicate slope in percent which is calculated by dividing the measured slope in mV by 59.16 and multiplying by 100.

#### **Troubleshooting**

Some pH instrument manufacturers suggest removing the pH probe and putting a shorting BNC connector or a short/paper clip across the input terminals and see if the instrument will zero correctly & display 0.00 mV or 7.0 pH. While this is a help it doesn't allow you to bring the slope adjustment back to nominal and doesn't even tell you if the pH instrument is capable of seeing a mV signal. For instance, an instrument with a defective or shorted preamplifier may display 0 mV or 7 pH with all input signals!

#### **Calibrating the pH transmitter or analyzer**

Disable the automatic temperature compensation (ATC) on the pH measuring instrument or manually set it to 25°C (77°F). Disconnect the pH probe from the instrument and connect the PIE Calibrator to the instrument with the calibrator set to output 7.000 pH (refer to the Operating Instructions for the PIE Calibrator). For a fast check of the pH instrument you may do a single point CAL or manually adjust the instrument to indicate 7 pH. Some instruments have a factory reset or reset to nominal. This will reset to nominal values both the OFFSET to 0.000 mV and the SLOPE of 59.16 mV/1 pH (known as a slope of 100%). If the instrument has a display of OFFSET mV the reading should be 000.0 mV  $\pm$  10 mV. If the OFFSET is greater than 10 mV there may be a problem in the wiring, preamplifier or in the instrument itself. For a full check of the operation of the instrument perform a two or three point CAL at the pH points recommended by the manufacturer. Dial the output of the PIE Calibrator to match the recommended buffer solutions such as 4.0, 7.0 and 10.0 or 4.10, 6.86 and 9.18 pH.



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Practical Instrument Electronics

82 E. Main Street Suite 3.14 • Webster, NY 14580 Tel: 585.872.9350 • Fax: 585.872.2638 • sales@piecal.com • www.piecal.com

## Verifying pH transmitter milliamp output

Example: a pH transmitter is ranged from 4 to 10 pH for a span of 6 pH. After you have completed verifying the pH input section it is time to verify the output of the transmitter. Set the PIE Calibrator to simulate 4 pH and verify the transmitter is outputting (or the control system sees) 4.00 mA. Now simulate 10 pH and verify the transmitter is outputting (or the control system sees) 20.00 mA. If the transmitter isn't outputting exactly 4.00 and 20.00 mA adjust the milliamp output per the manufacturer's instructions.



## Reconnecting & compensating for pH probe errors

Once you have verified proper output of the transmitter you may reattach the pH probe, turn automatic temperature compensation (ATC) back on and proceed with the probe calibration with buffer solutions. This step cannot be skipped – even new pH probes have some kind of OFFSET and SLOPE errors that must be corrected before the pH transmitter will measure to within specifications. After the instrument has been adjusted with a PIE Calibrator you MUST do a two or three point pH buffer calibration of the probe to match it with the instrument. Follow the instrument manufacturer's calibration procedure with the proper buffer solutions. If the OFFSET correction is greater than  $\pm 50$  mV or the SLOPE correction is not between 85 to 102% the probe will require cleaning or replacement. A typical response time for a pH probe is 30 to 60 seconds. If it takes more than 120 seconds (two minutes) to settle on a reading the probe requires reconditioning or requires replacement.

## Troubleshooting pH probes

There are many things that can go wrong with pH probes. Symptoms include slow or incorrect readings, noisy signals or no change in the reading at all. Some processes will cause a film to build up on the surface of the probe or clog the pores which requires physical cleaning or submersion in particular solutions. Other processes can poison one or both sides of the probe which can sometimes be fixed by submersion into solutions or replacement of the electrolyte. Probes that have dried out for short periods of time can often be brought back to proper operation. How long is a pH probe supposed to last? In a laboratory environment measuring mild solutions they can last for a year to 18 months. Under harsh process use they need to be replaced more often. For more information on care and cleaning of pH probes contact the manufacturer of your pH probe or instrumentation.

## PIE Calibrators with pH Simulation

Most calibrator manufacturers don't have ANY calibrators that simulate pH. Some of the PIE calibrators that include built-in simulation directly in pH are shown below.



**Model 235**

### Process Voltage Calibrator

Source & Read mV, V dc plus percent of 1 to 5 volts plus Simulate pH



**820-ELITE Multifunction Standard Process Calibrator**

Source & Read mA, V, Thermocouple, Ohms, RTD & Frequency plus Simulate pH and measure pressure with optional modules



**830 Process Calibrator**

### Dual Display & Loop Diagnostics

All the functions of the 820-ELITE plus a dual display and loop supply for stand alone calibration of 2-Wire transmitters. Advanced diagnostics finds hidden loop problems.

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