Loop closure after Calibration – Probes

By Mike Coleman, Cal Lab Manager

"I just got my probe recalibrated, so now I just hook it up to the readout, load the coefficients and start measuring. I don't have to worry about the probe's calibration until it's recalibrated, right?"

Surprisingly, this is exactly how many people handle their probes' calibrations. Following this practice saves a little time, but the cost can be severe. Recently, a company lost over a million dollars of product and six months of calibration work. The culprit was simply a PRT probe that shifted, probably during shipping, and wasn't checked before being returned to service. I hope this article will give you some ideas on how to make your temperature measurement program bulletproof by closing the loop on your probe calibrations.

What does "closing the loop" mean?

"Closing the loop" is completing the series of steps a probe should pass through as it is calibrated and used. In other words, there is more involved in managing a probe's calibration than just sending the probe out for calibration every year. The first step is a measurement taken to capture the status of the probe before it is boxed up and sent into shipping. This measurement closes the loop on the work the probe has done. When the probe is received back from calibration, another measurement is taken to verify that the probe didn't shift during return shipment. Both the send-off measurement and return measurement are compared with the calibration report. This enables you to monitor the status of the probe, and it also provides a crosscheck between the calibration lab and your lab. Measuring a probe before and after shipment may be the most important measurements in the overall calibration loop. Many probes and instruments are damaged beyond repair while in shipping. Make sure your work is closed out before shipping a probe.

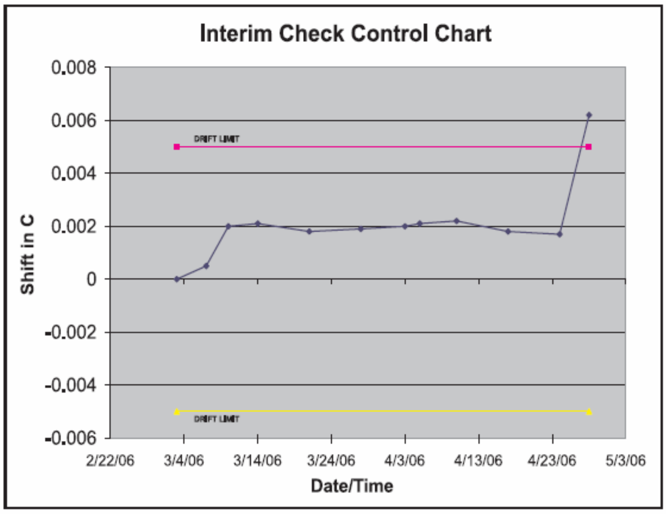
How do I know if the probe is in tolerance?

Just because the probe was calibrated and given a calibration certificate doesn't mean it was in tolerance. This might sound obvious, but I have had this conversation with enough customers to know that it is a common misconception. Someone who is surprised by this always follows up with the question "How do I know if the probe is in tolerance?" Basically, the tolerance status of a probe is calculated by comparing the new calibration with the previous calibration.

How can "out of tolerance" be avoided?

The goal of all measurement programs is to make sure that everything always works and nothing is out of tolerance. Of course, the better the measurement program, the less often instruments are out of tolerance. Measuring a probe as it is sent out for calibration and when it is received from calibration is good, but the probe also needs to be monitored as it is being used.

One of the difficulties in measuring temperature is that probes are typically very fragile so their performance is very dependent on care and handling. Manufacturers may spec a probe's long-term drift, but the only sure way to know the performance of a probe is by implementing interim checks and control charts (see the sample control chart in Figure 1). Whenever interim checks are mentioned, someone always says "Who has the time?" My answer is "Who has the time to recall six months or a year's worth of work?" In the situation mentioned earlier, a 30-minute check every week would have saved the company over a million dollars and six months of work.



Figue 1 Sample of Interim Check Control Chart

How often should the probe be checked?

There are no established rules that define how often an interim check should be done. One approach to establishing an interval is to decide the largest recall interval you are comfortable with and set the interim check interval accordingly. For example, if you calibrate 10 instruments a week with your temperature probe, then a weekly interim check may be sufficient. The largest risk would be the recall of 10 instruments.

A daily interim check would limit the risk to recalibration of two instruments. At each interim check, record the data on a spreadsheet or in a lab book. Graph the data. This is the beginning of a control chart. Add control lines to the chart to indicate how much the probe can drift before it exceeds the limits set in the calibration program (see Figure 1).

The sample control chart shows the data of a probe measured about every seven days. On 28th April 2008 the probe's shift was verified to be about 0.006 °C, which exceeds the process limit. Only four days of cal work may have to be recalled due to the shift.

What temperature points should be measured? This is an essential question to ask because, depending on the situation, many different temperatures can be used. Mainly, the temperature point(s) should be fairly simple to achieve and, importantly, the temperature point(s) must be repeatable. Let's go over a few options.

The triple-point of water (TPW), 0.010 °C, is most often used for closing the loop in probe calibrations. At Fluke 's Hart Scientific division, the TPW is measured multiple times in every platinum resistance thermometer (PRT) calibration to monitor the probe as it is calibrated. The TPW is very important in PRT calibrations because it can be used to troubleshoot several types of problems that affect PRT performance. Not only is the TPW included in every ITS-90 calibration, it is used in every ITS-90 measurement as well. The ITS-90 was designed to allow the user to update the probe's RTPW (resistance at the triple-point of water). Updating the RTPW coefficient can also help reduce errors due to probe drift. For these reasons, the TPW is the first choice for a quick check to verify and close the loop on a PRT.

For industrial level sensors that may not able to sustain an ITS-90 calibration such as probes using CVD coefficients or standard DIN classes, significant benefits can still be found in applying the techniques described above. A good quality dry well can be used to check the probes at 0'C and other techniques such as using crushed ice in a vacuum flask are valuable methods to detect drift and damage in probes used to maintain processes and quality.