GUIDELINES FOR HART PRODUCT SPECIFICATIONS

Not all manufacturers list the same specifications for similar products. Worse, not all manufacturers mean the same thing when they do. To help explain *our* specs, we offer the following guidelines.

Thermometer Probes

Calibration Uncertainty - This is the uncertainty with which a thermometer was calibrated and is only one component of its total measurement uncertainty. This specification can sometimes be improved by limiting the calibration of the thermometer to a narrower range or by calibrating it with fixed-point devices.

Stability or Repeatability - Many probes include a stability spec separate from calibration uncertainty and long-term drift. This figure includes all the uncertainties besides calibration uncertainty and long-term drift.

Probe Accuracy - For some probes, calibration uncertainty and short-term stability have been combined. This is the uncertainty of the thermometer without considering long-term drift effects.

Drift Rate - With use, particularly at high temperatures, resistance thermometers drift. Oxidation and handling are two of the biggest causes. Some drift effects can be reversed through annealing. Drift specs are usually limited by a given amount of time at high temperatures. With proper handling and less exposure to extreme temperatures, drift can be much less than the specification.

Immersion - The immersion requirement of a thermometer is difficult to state. The requirement changes with the medium in which the thermometer is immersed, the amount of thermal contact with the medium, and the difference between the medium's temperature and ambient temperature. Our specifications are therefore general guidelines assuming use in a typical fluid bath or in a dry-well with excellent thermal contact in typical ambient conditions.

Thermometer Readouts

Temperature Range - Because thermometer readouts are really ohm- or voltmeters, their "temperature" range is limited to their resistance or voltage range. The temperature ranges provided are guidelines. In most cases, the range of the probe becomes the real limiting factor.

Resistance (Voltage) Accuracy - The "accuracy" of a readout is best stated by the uncertainty with which it reads resistance or voltage. This is because all measurements are made in resistance or voltage and then translated into temperature using a user-selected conversion method. (The conversion algorithms in Hart readouts have been validated; no errors result from the mathematics in the conversion.) Readouts typically have different uncertainties for different resistance or voltage ranges. The temperature and type of probe being used must be considered when computing the accuracy of the readout. Our spec is for one year with k=2.

Temperature Accuracy - These numbers are guidelines only and do not include the uncertainty of the probe. Because readouts do not measure temperature directly, their true uncertainty can only be stated in terms of resistance or voltage. To determine temperature accuracy, the type and temperature of the probe must be considered.

Operating Temperature Range - The accuracy of a resistance device depends on ambient temperatures. Uncertainty specifications assume the unit is within its operating temperature range. A readout operating in the center of this range is more accurate than one operating on the edge, but both will meet the given specifications. Readouts will function outside the range but with less accuracy.

Baths

Stability - All stability numbers are "2-sigma" figures. This means that two times the standard deviation of a bath's temperature (over at least 30 minutes) will fall within the stated specification. Because bath stability varies with temperature and the fluid being used, they are also specified.

Uniformity - This is defined as the largest temperature difference found between two locations within the bath's working area (which is defined as 1 inch from the bottom and sides of the bath and 2 inches below the fluid's surface). Limiting work to an even smaller area can further reduce the gradient experienced during calibration. Uniformity is heavily dependent on the fluid being used.

Digital Setting Accuracy - The control probes used in fluid baths are not calibrated (unless requested) and are accurate to 0.5°C or 1.0°C. (External references are preferred for determining a bath's temperature.) Most baths, however, include set-point resolution to less than 0.001°C.

Dry-Wells

Accuracy - The control sensors—and therefore the displays—of industrial calibrators are calibrated using a reference thermometer, which was given an accredited, NIST-traceable calibration. Reliance on this accuracy depends on using the calibrator in a similar fashion to how it was calibrated—using 1/4" (or smaller) probes inserted snugly to the bottom of the well.

Stability - Stability numbers are "2-sigma" figures. This means that two times the standard deviation of a dry-well's temperature (over at least 30 minutes) will fall within the specification.

Well-to-Well Uniformity - This is the maximum temperature difference between two wells, assuming probes of similar size (less than 1/4") and construction are inserted to identical depths.