

An Intercomparison of First Principles Relative Humidity Reference Standards

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Abstract

Relative Humidity is a widely measured parameter throughout the manufacturing and calibration communities. Many types of sensors are in common use to perform measurements in a variety of applications. In some cases robust traceability is required and in others it is not, however, all of these sensors require calibration. As is the case with many physical parameters, the need for robust traceability, particularly in the world of accredited calibration, defies the seemingly simple nature of the measurement.

Fundamentally, traceability is achieved by calibration to a reference using appropriate procedures and with thorough uncertainty analysis. In the world of RH calibration, the national standard is the gravimetric chain or gravimetric hygrometer. Although capable of achieving extremely low uncertainties, the gravimetric approach is extremely difficult to implement and is not really viable for use as an everyday standard. As a result, most standards laboratories rely on one of two types of first principles systems to serve as reference standards: the chilled mirror hygrometer and the two-pressure humidity generator. Recently, the standing acoustic wave (SAW) hygrometer has been introduced which appears to have potential for becoming a viable secondary or transfer standard.

With the introduction of our new high accuracy RH data logger and the requirement for an accredited calibration, Hart Scientific found it necessary to undertake a project to determine which of several approaches would provide both the low uncertainties and high reliability necessary to meet the demands of the instrument. This paper describes both the theoretical limitations of the three approaches as well as the results of the intercomparison study.