C32 NIST Standard Reference Materials® (SRMs) for Forensic Measurements and Data Analysis

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This paper discusses the application of certified NIST Standard Reference Materials (SRMs) and the statistical analysis and interpretation of data related to laboratory calibrations and measurements used on the identification and/or comparison of specimens to be linked to forensic evi- dence. NIST SRMs provide the benchmarks to assess the levels of pre- cision and accuracy in the measurement of a range of physical and chemical property and performance characteristics.

NIST supports accurate and compatible measurements by providing over 1300 Certified SRMs with well-characterized composition and/or properties. These SRMs are used to perform instrument calibrations in situ as part of overall quality assurance programs, to verify the accuracy of spe- cific measurements and to support the development and standardization of new measurement methods. NIST SRMs are currently available for use in areas such as industrial materials production and analysis, environmental analysis, food and agriculture, radioactivity, health measurements, and basic measurements in science and metrology. Each SRM is supplied with a Certificate of Analysis. Along with standards organizations methods and procedures, such as those promulgated by ASTM and ANSI, NIST has pub- lished many articles and practice guides that describe the development, analysis and use of SRMs. NIST SRMs provide the benchmarks of pre- cision, accuracy, and traceability, which validate measurements and data.

The measurement of physical, optical and chemical properties of samples is often employed to identify the type of material and/or appli- cation. Measurements of material properties can be used to track and identify the original producer, the date or period of manufacture and the intended use or application for the material or product. For example, property or chemical measurements and/or the evaluation of samples or product characteristics, in addition to visual markings if present, can establish a link in the chain from producer, fabricator, distributor, vendor, end-use or application, down to a specific geographical area or sample origin.

In the measurement of properties, chemical composition, or charac- teristics of samples, accuracy and uncertainty terms and traceability state- ments are of paramount importance in forensic investigations for the vali-dation of data. These concepts must be used correctly to avoid possible confusion and inadmissibility of evidence. SRMs and the associated Certificate of Analysis state the intended purpose and application of a par-ticular SRM, its certified property value(s) with associated uncertainty(ies), and present technical information deemed necessary for its proper use. The uncertainty attached to a certified value is especially important as it repre- sents a quantity which characterizes the range of values within which the true value is asserted to lie within a stated level of confidence. A NIST SRM certificate bears the logo of the U.S. Department of Commerce, the name of NIST as certifying body, and the name and title of the NIST officer authorized to accept responsibility for its contents. In addition to the cer- tified values, the SRM certificate may contain references and/or other per-tinent information and data. SRMs certified values with their associated uncertainties, in applicable situations insure the integrity and the validation of forensic measurements and data. NIST certified values are obtained by one or more of the following measurement modes: 1) A definitive (or primary) method using specialized instrumentation capable of high accuracy and precision and whose errors have been thoroughly investigated and corrected; or, 2) Two or more independent methods at NIST using com- mercial instrumentation that is calibration based and with differing sources of systematic errors; or, 3) Interlaboratory data from selected laboratories using multiple methods and SRMs as controls. However, the sources of error with the latter mode will generally result in uncertainties greater than those for the other two modes.

There are a number of measurement methodologies related to the determination of materials properties and /or chemical composition. For instance chemical composition methods cover basic “wet chemistry” pro-cedures and other very sophisticated techniques, which utilize atomic and radiation physics principles, and nuclear interactions that require complex and expensive apparatus. Fortunately, a number of SRMs having compo- nents comparable with those of the materials to be evaluated have been established. These SRMs and associated methods or standard procedures are available for equipment calibrations.

This paper will discuss and illustrate the use of a number of a range of SRMs of interest to the forensic community. The discussion will encompass measurement practices, methods, standards, and precision and accuracy considerations to be taken into account for the measurement methodologies employed. This paper will also provide insights on the future needs for SRMs for forensic measurements and characterization.

Standards, Calibrations, Measurements

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