Designation: D 2865 – 95

An American National Standard

Standard Practice for Calibration of Standards and Equipment for Electrical Insulating Materials Testing[1]

This standard is issued under the fixed designation D 2865; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides for the establishment and maintenance of calibration procedures for measuring and test equipment used for electrical insulating materials. It provides a framework of concepts and practices, with definitions and specifications pertaining to measurement, adequacy of standards, necessary environmental controls, tables of corrections, intervals of calibration, calibration procedures, calibration of standards, and personnel training system documentation.

1.2 This practice is intended for control of the accuracy of the equipment used for measurements that are made in accordance with ASTM standards or other specified requirements.[2]

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

D 1711 Terminology Relating to Electrical Insulation[4]

D 2645 Tolerances for Yarns Spun on the Cotton or Worsted Systems[5]

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials[6]

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[7]

3. Terminology

3.1 *Definitions*—Many definitions concerning calibration of standards and equipment are generally understood or defined in other ASTM standards such as Practice E 177 and D 2645. Only those terms bearing on interpretations are described here.

3.1.1 See Terminology D 1711 for terms pertaining to electrical insulating materials.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *accuracy ratio, n*—see *uncertainty ratio.*

3.2.2 *adequacy of a standard, n*—the quality or state of a standard that exhibits and maintains the required accuracy and stability under the conditions of usage.

3.2.3 *calibration, n*—the process of comparing a standard or an instrument with one of greater accuracy (smaller uncertainty) for the purpose of obtaining quantitative estimates of the actual value of the standard being calibrated, the deviation of the actual value from the nominal value, or the difference between the value indicated by an instrument and the actual value.

3.2.3.1 *Discussion*—These differences are usually tabulated in a "Table of Corrections" which apply to that particular standard or instrument.

3.2.4 *calibration labeling, n— for measurement equipment or standards*, a means to indicate the date of latest calibration, by whom it was calibrated, and the due date for the next calibration.

3.2.5 *certification*—see *traceability to NIST (formerly NBS).*

3.2.5.1 *Discussion*—In the past, certification has been used to convey the meaning of either or both of the above terms. Since NIST no longer issues certificates of calibrations, the term has come to have a specialized meaning. The following is quoted from *NBS Special Publication 250*, "Calibration and Test Services of the National Institute of Standards and Technology", 1968 edition:

> "Results of calibrations and other tests are issued to the customer as formal reports entitled, "National Institute of Standards and Technology Report of Calibration", "National Institute of Standards and Technology Report of Test", or "National Institute of Standards and Technology Report of Analysis", as appropriate. Copies are not supplied to other parties. Whenever formal certification is required by law, or to meet special conditions adjudged by the National Institute of Standards and Technology to warrant it, a letter will be provided certifying that the particular item was received and calibrated or tested and identifying the report containing the results."

3.2.6 *degree of usage, n*—the summation of all factors bearing upon the stability of accuracy and reproducibility of a

[1] This practice is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.12 on Electrical Tests.

Current edition approved July 15, 1995. Published September 1995. Originally published as D 2865 – 70. Last previous edition D 2865 – 71 (1990).

[2] MIL-C-45662B, Military Specification Calibration Program Requirements, Draft 6, February, 1969.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 10.01.

[5] *Annual Book of ASTM Standards*, Vol 07.01.

[6] *Annual Book of ASTM Standards*, Vol 15.09.

[7] *Annual Book of ASTM Standards*, Vol 14.02.

standard or an instrument.

3.2.6.1 *Discussion*—Some, but not all, examples of such factors are: frequency of use; hours in service; hours on bench, in storage, and in transit; roughness in handling; number and nature of overloads; changes in ambient conditions such as temperature, humidity, vibration, contamination of insulators, electrical contacts, and mating surfaces; aging processes, especially of limited life components such as electron tubes; exposure to radiations, etc.

3.2.7 *environmental control*, *n*—the maintenance of ambient conditions within prescribed limits such as to ensure the validity of the calibrations of measuring and test equipment or standards.

3.2.7.1 *Discussion*—The value of a standard and the corrections for measuring equipment can be influenced by changes in temperature, humidity, pressure, radiation, etc., and it is necessary to place reasonable limits on these variables.

3.2.8 *interval of calibration*, *n*—the elapsed time permitted between calibrations as required by the pertinent specifications, or when not specified, as determined under procedures in this practice.

3.2.9 *qualified personnel*, *n*—persons adequately trained in the applicable test procedures, equipment operations, and calibration procedures.

3.2.10 *systematic error*, *n*—the inherent bias (offset) of a measurement process, or of one of its components.

3.2.11 *system control*, *n*—a recommended control of methods, procedures, and practices to ensure acceptable uniformity and continuity of equipment and personnel operations in a measuring system.

3.2.12 *traceability to NIST*, *n*—a documented chain of comparisons connecting a working standard (in as few steps as is practicable) to a standard maintained by the National Institute of Standards and Technology.

3.2.13 *uncertainty*, *n*—an allowance assigned to a measured value to take into account two major components of error: (*1*) the systematic error, and (*2*) the random error attributed to the imprecision of the measurement process.

3.2.14 *uncertainty ratio*, *n*—the ratio of the uncertainties of two standards.

4. Significance and Use

4.1 The accuracy and precision of any measurement can be established only with reference standards by processes involving comparisons and calibrations based upon a commonly accepted groundwork of standards and definitions. Even in those instances where the accuracy of a standard cannot be established, comparisons on a relative basis require that a reference standard be maintained, and that all comparisons be made in terms of deviations from this reference standard. Thus standards and calibrations are fundamental to the entire measurement process.

4.2 Conformance or non-conformance to specifications or standards agreed upon between the consumer and supplier can be established only by measurements and comparisons based upon a well defined and commonly accepted groundwork.

4.3 The accuracy and precision of measuring equipment may deteriorate with time, use, and environmental conditions. Unless sufficient accuracy is maintained, errors in test results may lead to the acceptance of faulty materials or workmanship, or the rejection of a satisfactory product.

5. System Control

5.1 To ensure uniformity of understanding and performance, and continuity of satisfactory operations when personnel changes occur, it is necessary that all proposed or existing procedures or practices intended to implement the equipment and standards calibration system be documented (preferably in book form). This documentation should provide a complete detailed plan for controlling the accuracy of every item of measuring and test equipment, and every measurement standard utilized. A method, procedure, or standard practice should be prescribed as follows:

5.1.1 A listing of all measurement standards with proper nomenclature and identification numbers.

5.1.2 A listing of intervals of calibration assigned for measuring and test equipment and for each measurement standard, both reference and transfer, and calibration sources designated for these items.

5.1.3 A listing of environmental conditions in which the standards, and measuring and test equipment are utilized and calibrated.

5.1.4 A listing of calibration procedures for all standards and equipment.

5.1.5 A listing of calibration reports for all measurement standards and for equipment whose accuracy requirement is such that a report is necessary.

5.1.6 Documented proof that the calibration system is coordinated with the inspection system or Quality Control Program.

5.1.7 Documented proof that provisions have been made by a system of periodic inspections or cross checks in order to detect differences, erratic readings, and other performance degrading factors which cannot be anticipated or provided for by calibration intervals. Also, that provisions have been made for timely and positive corrective action.

5.1.8 A listing of the coding system used for calibration labeling with explanations and specimens of labels, decals, reject tags, and the like.

5.1.9 Specimens of forms used in the laboratory's record system, such as instrument and gage record cards, data sheets, test reports, certifications, reject forms and the like, should be available.

5.1.10 Detailed results of all calibration and comparisons compiled separately for each standard or piece of equipment.

6. Environmental Control

6.1 Measuring and test equipment and measurement standards should be calibrated and utilized in an environment controlled to the extent necessary to ensure continued measurements of required accuracy, giving due consideration to temperature, humidity, vibration, cleanliness, and other controllable factors affecting precision measurements. The recommended environment is:

6.1.1 Calibrations of standards and equipment shall be performed in a standard laboratory atmosphere, as defined in Practice D 618. This specifies a temperature of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity. If any other atmosphere is required because of special considerations,