Standard Practice for

Establishing Requirements for Equipment Calibrations, Standardizations, and Checks

AASHTO Designation: R 61-12 (2020)[1]

Tech Subcommittee: 5c, Quality Assurance and Environmental

Release: Group 1 (April)

AASHTO

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1. SCOPE

1.1. This practice contains general criteria and guidelines for establishing requirements for equipment calibrations, verification of calibrations, standardizations, and checks. This practice is intended to be used for equipment and test methods not specifically addressed in R 18.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- T 176, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- T 201, Kinematic Viscosity of Asphalts (Bitumens)
- T 245, Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus

2.2. *International Standards*:

- *International Vocabulary of Metrology—Basic and General Concepts and Associated Terms* (VIM), Third Edition. International Organization for Standardization, Joint Committee for Guides on Metrology, Sèvres, France, 2008.
- ISO 5725-1, Accuracy (Trueness and Precision) of Measurement Methods and Results´ Part 1: General Principles and Definitions
- ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
- *Evaluation of Measurement Data—Guide to the Expression of Uncertainty in Measurement* (GUM). International Organization for Standardization, Joint Committee for Guides on Metrology, Sèvres, France, 2008. The U.S. edition of the GUM is entitled *American National Standard for Expressing Uncertainty—U.S. Guide to the Expression of Uncertainty in Measurement*, ANSI/NCSL Z540-2-1997 (R2012).

3. TERMINOLOGY

3.1. *accuracy of measurement´* closeness of the agreement between the result of a measurement and a true value of the measurand (VIM, Section 3.5).

3.1.1. *Discussion*—Part 1 of the international standard ISO 5725-1 on the accuracy of measurement methods and results defines accuracy as the closeness of agreement between a test result and the accepted reference value. This definition is supplemented by a note that states that the term `accuracy,_ when applied to a set of test results, involves a combination of random components and a common systematic error or bias component. Accuracy is thus viewed as a characteristic of a measurement process consisting of precision as well as bias components. A process is considered to be accurate only if it is precise as well as unbiased.

The expanded uncertainty of a measurement, discounting the bias, is equivalent to the accuracy of the measurement after a correction or correction factor is applied.

3.2. *calibration, n´* a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or between values represented by a material measure or a reference material, and the corresponding values realized by standards (VIM, Section 6.11).

3.2.1. *Example´* Balances (measurement instrument), Dynamic Shear Rheometer (measuring system), Pycnometer (material measure).

3.2.2. *Discussion´* The purpose of calibration is to ensure that measurements made by the laboratory are traceable to the International System of Units (SI). Where traceability of measurements to SI units is not possible or relevant, measurements must be traceable to certified reference materials, agreed methods, or consensus standards. Uncertainty estimates obtained during calibration are used to judge if an instrument is suitable for its intended purpose. There is a need to reestablish traceability or recalibrate only when instrument measurements drift out of control [as determined through verification of calibration (Section 3.10)].

3.3. *check, n´* a specific type of inspection and/or measurement performed on the physical properties of equipment and materials to determine compliance or otherwise with stated criteria.

3.4. *correction, n´* value added algebraically to the uncorrected result of a measurement to compensate for systematic error (VIM, Section 3.15).

3.4.1. *Discussion´* Because the systematic error cannot be known perfectly, the correction can only be an estimate.

3.5. *correction factor, n´* numerical factor by which the uncorrected result of a measurement is multiplied to compensate for systematic error (VIM, Section 3.16).

3.5.1. *Discussion´* Because the systematic error cannot be known perfectly, the correction factor can only be an estimate.

3.6. *standard, n*—material measure, measuring instrument, reference material, or measuring system intended to define, realize, conserve, or reproduce a unit of one or more values of a quantity to serve as a reference (VIM, Section 6.1).

3.7. *standardization, n´* a process that determines (1) the correction or correction factor to be applied to the result of a measuring instrument, measuring system, material measure, or reference material when its values are compared to the values realized by standards, (2) the adjustment to be applied to a piece of equipment when its performance is compared with that of an accepted standard or process.

3.7.1. *Discussion´* Standardization in case (1) is a simplified form of calibration that estimates systematic error but does not identify random error. Standardization, therefore, does not address all of the elements of uncertainty of measurement and does not lead to traceable measurements.