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Standard Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing¹

This standard is issued under the fixed designation D4753; 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 guide provides minimum requirements for general-purpose balances and standard masses used in testing soil, rock, and related construction materials.

1.2 This guide provides guidance for evaluating, selecting, and specifying general purpose balances and standard masses used in testing soil, rock, and related construction materials.

1.3 The accuracy requirements for balances are specified in terms of the combined effect of all sources of error contributing to overall balance performance. The measurement of specific sources of error and consideration of details pertaining to balance construction has been intentionally avoided.

1.4 This guide does not include requirements for balances having accuracies greater than those generally required in testing soil, rock, and related construction materials or for research programs or specialized testing requirements.

1.5 This guide does not apply to nongraduated balances.

1.6 This guide does not address the methods used to verify or quantify specific parameters dealing with balances. For a description of tests used in evaluating balance performance, see NIST Handbook 44.

1.7 This guide is not intended to be used as a specification for the purchase of balances.

NOTE 1—The National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS), and the International Organization of Legal Metrology (OIML) publish standards or practices that specify construction requirements as well as performance guides for balances. ASTM, OIML, and NIST publish construction standards and tolerances for standard masses.

NOTE 2—The terms “mass” and “determine the mass of” are used in this standard instead of the more commonly used terms “weight” and “weigh” to comply with standard metric practice. In addition, the term “standard mass(es)” is used instead of “standard weight(s)” when referring to a piece

of material of known specified mass used to compare or measure the mass of other masses.

1.8 The values states in SI units are to be regarded as standard.

1.9 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged nor should this document be applied without consideration of a project’s many unique aspects. The word “Standard” in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.10 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[E617 Specification for Laboratory Weights and Precision Mass Standards](#)

¹ This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.95 on Information Retrieval and Data Automation.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

2.2 *National Institute of Standards and Technology Documents:*

NIST Handbook 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices³

2.3 *International Organization for Legal Metrology (OIML):*⁴

International Recommendations OIML R 76–1 and R 76–2 Non-automatic weighing instruments

Part 1: Metrological and technical requirements—Tests Edition 2006 (E) Non-automatic weighing instruments

Part 2: Test report format Edition 2007 (E)

International Recommendations OIML R 111–1 Edition 2004 (E) Weights of classes E₁, E₂, F₁, F₂, M₁, M_{1–2}, M₂, M_{2–3}, and M₃

Part 1: Metrological and technical requirements

International Recommendations OIML R 111–2 Edition 2004 (E) Weights of classes E₁, E₂, F₁, F₂, M₁, M_{1–2}, M₂, M_{2–3}, and M₃

Part 2: Test Report Format

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide refer to Terminology **D653**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *balance, n*—an instrument for determining the mass of an object by the action of gravity on the object.

3.2.2 *basic condition, n*—a condition that must be met before a basic measurement for evaluating a balance can be performed.

3.2.3 *basic measurement (of error), n*—evaluating a balance by determining the change of indication of the balance when a known mass is added to or subtracted from any mass already on the balance and the difference between the change in the indication determined and the known value of the mass.

3.2.4 *basic tolerance, n*—tolerances that are established by a particular code for a particular device under all normal tests, whether maintenance or acceptance.

3.2.4.1 *Discussion*—Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances.

3.2.5 *capacity, n—of a balance*, the maximum mass recommended by the manufacturer, disregarding any additional capability supplied by a taring device.

3.2.6 *general-purpose balance, n*—any balance used to make a laboratory, industrial, education, and home use determination of mass.

3.2.7 *general-purpose determination of mass, n*—a single determination of mass using a balance (not a special purpose

determination of mass involving repeat determinations of mass, for example, averages, standard deviations, and corrections).

3.2.8 *general-purpose standard mass, n*—a standard mass used with a balance to make a general purpose determination of mass. See *general-purpose determination of mass*.

3.2.9 *hysteresis, n*—the difference between successive measurements of a standard mass when the standard mass is measured after a cycle of adding, and then removing (or removing, then adding) mass from the balance.

3.2.10 *linearity error, n*—in balances, this expression is applied to the plus or minus deviation from the theoretically straight-lined (linear) course of two interdependent values of the indicated measurement value from the true (actual) value of the mass.

3.2.10.1 *Discussion*—Linearity implies that the deviation from the true values are a continuous function of the applied mass. Thus, obtaining enough values of the true applied mass versus balance reading to establish a relation between applied mass and output should give the error that will occur at any applied mass. Linearity, then, is a statement about the systematic (nonrandom) error of a balance. Superimposed on the linearity are precision and other effects, such as off-center errors and temperature effects. Linearity is a measure of balance performance over its full range, and on most balances adjustments can be made to alter the useableness of a balance with a given linearity for measurements within a particular range of use.

3.2.11 *nongraduated balance, n*—balances not fitted with a bar numbered in units of mass.

3.2.12 *off-center error, n—of a top loading or platform balance*, the difference in indicated value when a mass is shifted to various positions on the loading area (pan or platform); eccentric load error.

3.2.12.1 *Discussion*—The test for off-center error is called the shift test, or off center-load test. Information about balance performance under eccentric loadings is not normally found in product literature but such information can usually be obtained by contacting the manufacturer directly.

3.2.13 *precision of a balance, n*—the degree of agreement between the indications of a balance for repeated determinations of the same mass under essentially the same conditions.

3.2.13.1 *Discussion*—Precision of a balance is usually expressed quantitatively as a standard deviation of a series of mass determinations, or as a function of the range of several mass determinations.

3.2.14 *readability type I, n*—the value of the smallest unit of mass that can be read without estimation over the given range of measurement either directly or by use of a vernier or micrometer.

3.2.15 *readability type II, n*—the value of the smallest unit of mass that can be read *with* estimation over the given range of measurement.

3.2.16 *readability type III, n*—the value of the smallest unit of mass that can be read when in-service conditions such as

³ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

⁴ Available from International Organization of Legal Metrology, 11 rue Turgot, 75009 Paris, France, <http://www.oiml.org>.