



Designation: ~~C1005—19~~ C1005 – 20

Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements¹

This standard is issued under the fixed designation C1005; 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 specification covers the minimum requirements for scales, balances, reference masses, and glass graduates used in the physical testing of hydraulic cements.

1.2 Requirements for analytical reference masses and balances are not included in this specification, but are to be found in Test Methods **C114**. The use of restrictive terminology, classes, ranges, and so forth has been intentionally avoided to allow the use of this specification by other standards-writing bodies with similar requirements for reference masses and devices for determining mass, if desired.

1.3 These requirements are not sufficiently descriptive to be used as the sole specifications for the purchase of reference masses or devices for determining mass without amplification.

1.4 Values in SI units shall be obtained by measurement in SI units or by appropriate conversion, using the Rules for Conversion and Rounding given in **IEEE/ASTM SI-10**, of measurement made in other units.

1.5 *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

C114 Test Methods for Chemical Analysis of Hydraulic Cement

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E617 Specification for Laboratory Weights and Precision Mass Standards

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 Definitions:

¹ This specification is under the jurisdiction of ASTM Committee **C01** on Cement and is the direct responsibility of Subcommittee **C01.95** on Coordination of Standards. Current edition approved April 1, 2019; Nov. 15, 2020. Published April 2019; December 2020. Originally approved in 1983. Last previous edition approved in 2018 as ~~C1005—18~~; ~~C1005 – 19~~. DOI: ~~10.1520/C1005-19~~; ~~10.1520/C1005-20~~.

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

3.1.1 *accuracy, n*—degree of conformity of the indication of a device for determining mass to the true value of an applied mass.

3.1.2 *balance, n*—a device for determining mass that compares a mass with standard masses.

3.1.3 *precision, n*—reproducibility of the readings of a device for determining mass when a given test mass is applied.

3.1.4 *range of mass determination, n*—the range of indications of a device from the minimum test load plus any aids or containers on the load-receiving elements to the maximum test load with the same aids or containers, as specified by the particular method of test being used.

3.1.5 *readability, n*—(analog display) the ~~smallest~~ fraction of a ~~the smallest~~ division to which the index scale of a device for determining mass can be read ~~with ease either~~ by estimation or by use of a vernier.

3.1.5.1 *Discussion*—

If the distance between adjacent smallest division marks is less than 1.6 mm, the readability is 1/2 of a division. If the distance between adjacent smallest division marks is more than 1.6 mm the readability is 1/3 of a division.

3.1.6 *readability, n*—(digital display) the least significant digit indicated by the digital display.

3.1.7 *reference mass, n*—a piece of material of known specified mass for use in comparing or measuring the mass of other masses (see **Note 1**).

3.1.7.1 *Discussion*—

The definition of “reference mass” was formerly incorrectly designated “weight;” weight is a force (see **IEEE/ASTM SI-10**).

3.1.8 *scale, n*—a device for determining mass having a load-receiving element and an index scale (possibly in combination with the use of internal masses or proportional masses), almost always calibrated to indicate mass; generally of lesser accuracy than a balance.

3.1.9 *sensitivity, n*—the minimum change of applied mass required to perceptibly move the indicating element of a device for determining mass.

3.1.10 *sensitivity requirement, n*—the minimum change in position of rest of the indicating element of a device for determining mass in response to a specified change of mass load on the load-receiving element.

3.1.11 *test load, n*—the mass to be determined in a single determination, exclusive of aids or containers, as specified in the test method being followed.

3.1.12 *tolerance, n*—precision and accuracy criteria for reference masses or devices for determining mass.

acceptance tolerance—the maximum permissible deviation from correct indication for new or newly reconditioned or adjusted reference masses or devices for determining mass; equal to 1/2 the maintenance tolerance.

adjustment tolerance—acceptance tolerance.

maintenance tolerance—maximum permissible deviation from correct indication for reference masses and devices for determining mass in service.

3.1.13 *total load, n*—the sum of the masses of materials and aids or containers applied to the load-receiving element at any one time.

4. Reference Masses

4.1 Reference masses for use in the methods of physical testing of hydraulic cement and related and similar materials shall conform at least to the requirements of Class 6 reference masses in Specification **E617**, except that the maintenance tolerances given in Specification **E617** for Class 6 reference masses are to be considered acceptance tolerances for purposes of this specification and the maintenance tolerances twice these values. See **Table 1**. (See **Note 1**.)

NOTE 1—Former NBS Class P and F reference masses meet this specification as do OIML Class M1 reference masses. Former NBS Class T reference

masses of 100 mg and less, Class C reference masses of 1 kg and greater, and OIML Class M2 reference masses of 200 g and greater meet the specification.

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4.2 A mass used strictly as a mass, whose actual value need not be known, need not meet the requirements of 4.1 (see Note 2).

NOTE 2—A tare mass for a container used in mass determination is in this category. The actual value of its mass need not be known, but it must be equal in mass to that of the container.

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5. Requirements for Scales and Balances

TABLE 1 Tolerances for Reference Masses^{A,B}

Mass, g	Acceptance Tolerance, ±mg	Maintenance Tolerance, ±mg
10 000	1 000	2 000
5 000	500	1 000
3 000	300	600
2 000	200	400
1 000	100	200
500	50	100
300	30	60
200	20	40
100	10	20
50	7	14
30	5	10
20	3	6
10	2	4
5	2	4
3	2	4
2	2	4
1	2	4

^A Values from Table 1 of Specification E617 for Class 6 metric reference masses.

^B For reference masses with unlisted nominal values, the tolerance shall be that for the next lower denomination listed.

5.1 *Capacity*—The capacity of a device for mass determination shall be at least equal to the maximum total load to be applied to the load-receiving element at any one time (see Note 3).

NOTE 3—In general, the capacity of a device for mass determination should not greatly exceed twice the maximum total load required for a given test because of the reduced accuracy, readability, and sensitivity with higher capacity weighing devices. There are exceptions to this generality as, for example, the high quality substitution balances.

5.2 *Precision and Accuracy—Accuracy Requirement*—The maintenance tolerance for a device for mass determination shall be no greater than 0.05 % of the test load throughout the test load range. For balances with a capacity of 3000 g or more, the range of the test load shall be 300 to 3000 g. For balances with a capacity of less than 3000 g, the range of the test load shall be 10 % of the capacity up to the capacity of the balance. The device for mass determination shall be capable of reproducing readings with the same test mass to within at least the maintenance tolerance.

5.3 *Readability—Readability Requirement*—The index scale of a device for mass determination with capacity greater than 1000 g shall be easily readable to have a readability no greater than 0.1 g. The index scale of a device for mass determination with capacity 1000 g or less shall be easily readable to 0.01 g.

5.4 *Sensitivity Requirement*—The indicating element of the device for determination of mass shall show a change of at least one of the smallest divisions of the index scale for scale, or a change of 0.1 % of the test load within the test load range, the least significant digit on a digital scale.

5.5 Mass values calculated in 5.2 and 5.4 shall be rounded to the nearest 0.01 g or the nearest 0.1 g in accordance with the rounding method of Practice E29, depending on the device readability as determined in 5.3.

6. Requirements for Glass Graduates

6.1 *Glass Graduates*, of suitable capacities (large enough to measure the mixing water for paste and mortar mixtures in a single operation) shall be made to deliver the indicated volume at 20°C (68°F); 20°C (68°F).

6.1.1 The permissible variation for graduates of 100 to 150 mL capacities shall be ±1.0 mL, for graduates of 200 to 300 mL capacities ±2.0 mL, and for all larger graduates ±0.5 % of the rated capacity.

6.1.2 These graduates shall be subdivided to at least 5 mL with the following exceptions:

6.1.2.1 The graduation lines may be omitted for the lowest 15 mL for a 150 mL graduate,

6.1.2.2 The graduation lines may be omitted for the lowest 20 mL for a 200 mL graduate,

6.1.2.3 The graduation lines may be omitted for the lowest 25 mL for a 250 mL graduate, and

6.1.2.4 The graduation lines may be omitted for the lowest 50 mL for a 500 mL graduate.

6.1.3 The main graduation lines shall extend at least three quarters of the way around the graduate and shall be numbered (Note 4).

NOTE 4—Some graduates are manufactured with two numbering systems; one on each side of the main graduation lines. In reading from bottom to top, one system is increasing while on the other side the numbers are decreasing. Care should be taken since this could create confusion in reading the volume.

7. Verification Timing

7.1 New or newly reconditioned or adjusted reference masses and devices for determination of mass shall not be placed in service if they do not meet the acceptance tolerances specified in this standard.