Designation: C1005 – 17

Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements[1]

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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C114 Test Methods for Chemical Analysis of Hydraulic Cement

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:*

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*—the smallest fraction of a 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.

3.1.6 *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).

3.1.6.1 *Discussion*—The definition of "reference mass" was formerly incorrectly designated "weight;" weight is a force (See IEEE/ASTM SI–10).

3.1.7 *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.

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

3.1.9 *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.

3.1.10 *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.

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

[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.

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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**

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 ½ 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.

3.1.12 *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.

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.

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. Requirements for Scales and Balances

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*—The maintenance tolerance for a device for mass determination shall be no greater than 0.05 % of the test load throughout the 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*—The index scale of a device for mass determination shall be easily readable to 0.1 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 a change of 0.1 % of the test load within the range.

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).

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 25 mL for a 250-mL graduate, and

6.1.2.3 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.

7.2 Reference masses and devices for determination of mass in service shall be checked annually and shall be removed from service if they exceed the maintenance tolerances specified in this standard (See Note 5).

NOTE 5—An optional performance verification procedure is provided in Appendix X1.

7.3 *Record Verification Requirement*—Maintain documentation of the reference mass verification in the laboratory. Include in the documentation the date and the mass determination when verified.

8. Keywords

8.1 devices for determining mass; devices for measuring volume; glass graduate; reference masses

APPENDIX

(Nonmandatory Information)

X1. SCALE AND BALANCE PERFORMANCE VERIFICATION

X1.1 This check mass verification procedure may be used to verify the continuing precise performance of a scale or balance. Perform this procedure in addition to the annual verification procedure.

X1.1.1 The verification check mass shall be made of corrosion-resisting material (for example, material conforming to Specification E617 Class 6 masses) and shall have a stable mass. The check mass used for this purpose need not conform to any tolerance.

X1.1.2 The check mass must satisfy the size requirements for the reference test mass as described in the "Precision and Accuracy" paragraph (5.2).

X1.1.3 Dedicate the check mass to the verification process to prevent any alternate uses from damaging or altering the mass.

X1.1.4 Make one mass determination using a single check mass on the selected scale or balance.

X1.1.5 Maintain documentation of this verification in the laboratory. Include in the documentation the date and the mass determination when verified. If the difference between the current reading and the previous reading exceeds the maintenance tolerance of the similar sized reference mass as listed in Table 1, test the balance or scale for conformance to this standard with reference masses and adjust or replace the scale or balance as appropriate.

X1.1.6 In the event of an adjustment or replacement, establish a new check mass determination value for the verification and make no comparison until the next scheduled verification.

X1.1.7 Perform this procedure routinely and whenever scale or balance performance verification is desired.

SUMMARY OF CHANGES

Committee C01 has identified the location of selected changes to this standard since the last issue (C1005 – 10) that may impact the use of this standard. (Approved March 15, 2017.)

(1) Added new Subsection 7.3.