



Standard Test Method for Density of Hydraulic Cement¹

This standard is issued under the fixed designation C188; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the density of hydraulic cement. Its particular usefulness is in connection with the design and control of concrete mixtures.

1.2 The density of hydraulic cement is defined as the mass of a unit volume of the solids.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 **Warning**—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²

1.5 *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*:³

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C125 Terminology Relating to Concrete and Concrete Aggregates

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology **C125**.

4. Significance and Use

4.1 This test method provides a procedure for the determination of density of hydraulic cement samples using non-instrumental techniques.

5. Apparatus

5.1 *Le Chatelier flask*—The standard flask, which is circular in cross section, with shape and dimensions conforming essentially to **Fig. 1** (Note). The requirements in regard to tolerance, inscription and length, spacing, and uniformity of graduation will be rigidly observed. There shall be a space of at least 10 mm between the highest graduation mark and the lowest point of grinding for the glass stopper.

5.1.1 The material of construction shall be excellent quality glass, transparent and free of striae. The glass shall be chemically resistant and shall have small thermal hysteresis. The flasks shall be thoroughly annealed before being graduated. They shall be of sufficient thickness to ensure reasonable resistance to breakage.

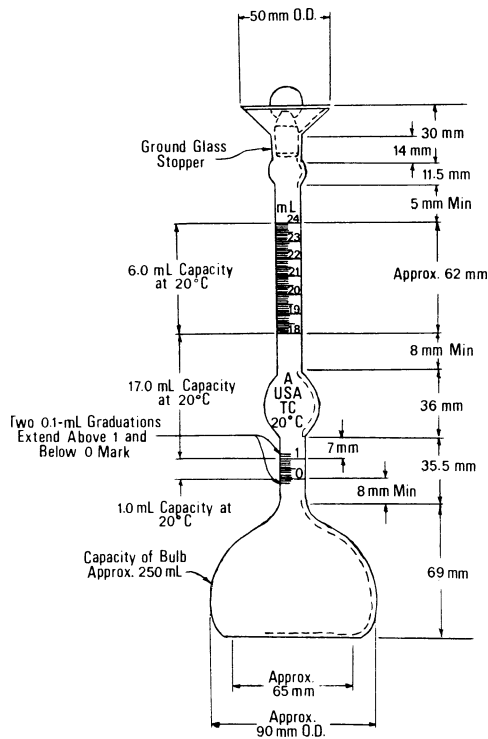
5.1.2 The neck shall be graduated from 0 to 1 mL and from 18 to 24 mL in 0.1-mL graduations. The error of any indicated capacity shall not be greater than 0.05 mL.

¹ This test method is under the jurisdiction of ASTM Committee **C01** on Cement and is the direct responsibility of Subcommittee **C01.25** on Fineness. Current edition approved July 1, 2014/Oct. 1, 2015. Published July 2014/October 2015. Originally approved in 1944. Last previous edition approved in 2009/2014 as **C188 – 09-C188 – 14**. DOI: 10.1520/C0188-14.10.1520/C0188-15.

² Section on Safety, Manual of Cement Testing, *Annual Book of ASTM Standards*, Vol. 04.01.

³ 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



Note—Variations of a few millimetres in such dimensions as total height of flask, diameter of base, and so forth, are to be expected and will not be considered sufficient cause for rejection. The dimensions of the flask shown in Fig. 1 apply only to new flasks and not to flasks in use which meet the other requirements of this test method.

FIG. 1 Le Chatelier Flask for Density Test

5.1.3 Each flask shall bear a permanent identification number and the stopper, if not interchangeably ground, shall bear the same number. Interchangeable ground-glass parts shall be marked on both members with the standard-taper symbol, followed by the size designation. The standard temperature shall be indicated, and the unit of capacity shall be shown by the letters “mL” placed above the highest graduation mark.

5.2 Kerosine, free of water, or naphtha, having a density greater than 0.73 g/mL at $23 \pm 2^\circ\text{C}$ shall be used in the density determination.

5.3 The use of alternative equipment or methods for determining density is permitted provided that a single operator can obtain results within $\pm 0.03 \text{ g/cm}^3$ of the results obtained using the flask method.

NOTE 1—The design is intended to ensure complete drainage of the flask when emptied, and stability of standing on a level surface, as well as accuracy and precision of reading.

6. Procedure

6.1 Determine the density of cement on the material as received, unless otherwise specified. If the density determination on a loss-free sample is required, first ignite the sample as described in the loss on ignition section on Portland Cement of Test Methods C114.

6.2 Fill the flask (Note 2) with either of the liquids specified in 5.2 to a point on the stem between the 0 and the 1-mL mark. Dry the inside of the flask above the level of the liquid, if necessary, after pouring. Weigh the flask, containing the liquid, and record the mass, M_a , to the nearest 0.05 g. Record the first reading of liquid height after the flask has been immersed in the water bath (Note 3) in accordance with 6.4.

NOTE 2—It is advisable to use a rubber pad on the table top when filling or rolling the flask.

NOTE 3—Before the cement has been added to the flask, a loose-fitting, lead-ring weight around the stem of the flask will be helpful in holding the flask in an upright position in the water bath, or the flask may be held in the water bath by a buret clamp.

6.3 Introduce a quantity of cement, weighed to the nearest 0.05 g, (about 64 g for portland cement) cement in small increments at the same temperature as the liquid (Note 2) sufficient to bring the liquid level in its final position to some point within the upper series of graduation (Note 4). Take care to avoid splashing and see that the cement does not adhere to the inside of the flask above the liquid-liquid (Note 5). A vibrating apparatus may be used to accelerate the introduction of the cement into the flask and to prevent the cement from sticking to the neck. After all the cement has been introduced, weigh the flask again to the nearest 0.05 g and record the mass, M_r . Then, place the stopper in the flask and roll the flask in an inclined position (Note 2), or gently whirl it in a horizontal circle, so as to free entrapped air from the cement until no further air bubbles rise to the surface of the liquid.