



# Standard Test Method for Normal Consistency of Hydraulic Cement<sup>1</sup>

This standard is issued under the fixed designation C 187; 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 approval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the normal consistency of hydraulic cement.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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. See 1.4 for a specific warning statement.*

1.4 **Warning**—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure. The use of gloves, protective clothing, and eye protection is recommended. Wash contact area with copious amounts of water after contact. Wash eyes for a minimum of 15 min. Avoid exposure of the body to clothing saturated with the liquid phase of the unhardened material. Remove contaminated clothing immediately after exposure.<sup>2</sup>

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

**C 305** Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

**C 490** Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete

**C 1005** Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements

**D 1193** Specification for Reagent Water

**E 177** Practice for Use of the Terms Precision and Bias in

## ASTM Test Methods

### 3. Significance and Use

3.1 This test method is intended to be used to determine the amount of water required to prepare hydraulic cement pastes for testing.

### 4. Apparatus

4.1 *Reference Masses and Devices for Determining Mass*, conforming to the requirements of Specification **C 1005**. The devices for determining mass shall be evaluated for precision and bias at a total load of 1000 g.

4.2 *Glass Graduates*, 200 or 250-mL capacity, and conforming to the requirements of Practice **C 490**.

4.3 *Vicat Apparatus*—The Vicat apparatus shall consist of a frame *A* (**Fig. 1**) bearing a movable rod *B*, weighing 300 g, one end *C*, the plunger end, being 10 mm in diameter for a distance of at least 50 mm, and the other end having a removable needle *D*, 1 mm in diameter and 50 mm in length. The rod *B* is reversible, and can be held in any desired position by a set screw *E*, and has an adjustable indicator *F*, which moves over a scale (graduated in millimetres) attached to the frame *A*. The paste is held in a rigid conical ring *G*, resting on a plane nonabsorptive square base plate *H*, about 100 mm on each side. The rod *B* shall be made of stainless steel having a hardness of not less than 35 HRC (See **Note 1**), and shall be straight with the plunger end which is perpendicular to the rod axis. The ring shall be made of a noncorroding, nonabsorbent material, and shall have an inside diameter of 70 mm at the base and 60 mm at the top, and a height of 40 mm. In addition to the above, the Vicat apparatus shall conform to the following requirements:

Weight of movable rod	300 ± 0.5 g (0.661 lb ± 8 grains) in
Diameter of plunger end of rod	10 ± 0.05 mm (0.394 ± 0.002 in.)
Diameter of needle	1 ± 0.05 mm (0.039 ± 0.002 in.)
Inside diameter of ring at bottom	70 ± 3 mm (2.75 ± 0.12 in.)
Inside diameter of ring at top	60 ± 3 mm (2.36 ± 0.12 in.)
Height of ring	40 ± 1 mm (1.57 ± 0.04 in.)
Graduated scale	The graduated scale, when compared with a standard scale accurate to within 0.1 mm at all points, shall not show a deviation at any point greater than 0.25 mm.

**NOTE 1**—The requirement that the rod be made of stainless steel shall apply only to new Vicat apparatus or replacement rods and not to equipment in use which meets the other requirements of this test method.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.22 on Workability.

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

<sup>3</sup> 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.

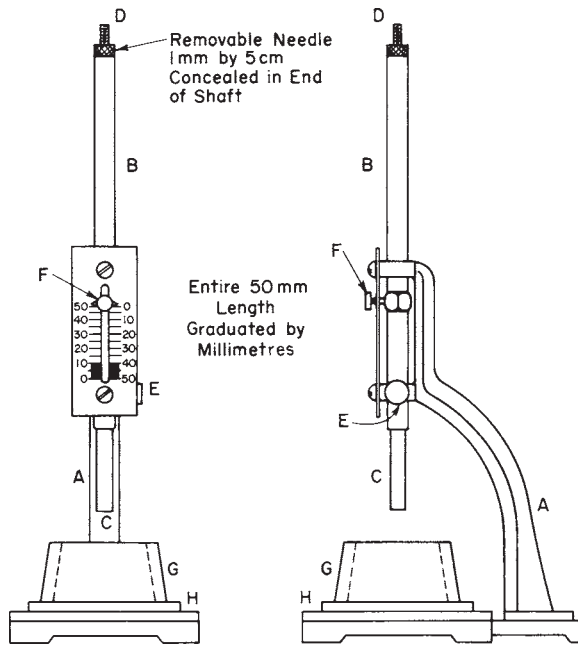


FIG. 1 Vicat Apparatus

4.4 *Flat Trowel*, having a sharpened straight-edged steel blade 100 to 150 mm in length.

## 5. Temperature and Humidity

5.1 The temperature of the air in the vicinity of the mixing slab, the dry cement, molds, and base plates shall be maintained between 20 and 27.5 °C (68 and 81.5 °F). The temperature of the mixing water shall not vary from 23.0 °C (73.5 °F) by more than  $\pm 2.0$  °C (3.5 °F).

5.2 The relative humidity of the laboratory shall be not less than 50 %.

## 6. Procedure

6.1 *Preparation of Cement Paste*—Mix 650 g of cement with a measured quantity of water following the procedure prescribed in the Procedure for Mixing Pastes of Practice C 305. The water shall conform to the numerical limits of Specification D 1193 for Type III or Type IV grade of reagent water.

6.2 *Molding Test Specimen*—Quickly form the cement paste, prepared as described in 6.1, into the approximate shape

of a ball with gloved hands. Then toss six times through a free path of about 150 mm (6 in.) from one hand to another so as to produce a nearly spherical mass that may be easily inserted into the Vicat ring with a minimum amount of additional manipulation. Press the ball, resting in the palm of one hand, into the larger end of the conical ring G, Fig. 1, held in the other hand, completely filling the ring with paste. Remove the excess at the larger end by a single movement of the palm of the hand. Place the ring on its larger end on the base plate H, and slice off the excess paste at the smaller end at the top of the ring by a single oblique stroke of a sharp-edged trowel held at a slight angle with the top of the ring, and smooth the top, if necessary, with a few light touches of the pointed end of the trowel. During these operations of cutting and smoothing, take care not to compress the paste.

6.3 *Consistency Determination*—Center the paste confined in the ring, resting on the plate, under the rod B, Fig. 1, the plunger end C of which shall be brought in contact with the surface of the paste, and tighten the set-screw E. Then set the movable indicator F to the upper zero mark of the scale, or take an initial reading, and release the rod immediately. This must not exceed 30 s after completion of mixing. The apparatus shall be free of all vibrations during the test. The paste shall be of normal consistency when the rod settles to a point  $10 \pm 1$  mm below the original surface in 30 s after being released. Make trial pastes with varying percentages of water until the normal consistency is obtained. Make each trial with fresh cement.

## 7. Calculation

7.1 Calculate the amount of water required for normal consistency to the nearest 0.1 % and report it to the nearest 0.5 % of the weight of the dry cement.

## 8. Precision and Bias

8.1 The single operator-instrument precision has been found to be 0.25 (1S), and the multilaboratory precision has been found to be 0.35 (1S) as defined in Practice E 177; therefore, the results of two properly conducted tests by the same operator in a laboratory should agree within 0.7 percentage point, and test results between two laboratories should agree with 1.0 percentage point 95 % of the time.

## 9. Keywords

9.1 consistency; normal consistency; Vicat needles

For additional useful information on details of cement test methods, reference may be made to the “Manual of Cement Testing,” which appears in the *Annual Book of ASTM Standards*, Vol 04.01.

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