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Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle¹

This standard is issued under the fixed designation C191; 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 These test methods determine the time of setting of hydraulic cement by means of the Vicat needle. Two test methods are given; Test Method A is the Reference Test Method using the manually operated standard Vicat apparatus, while Test Method B permits the use of an automatic Vicat machine that has, in accordance with the qualification requirements of this method, demonstrated acceptable performance.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use. (Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.)*²

1.4 The text of these test methods reference notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

NOTE 1—For the test method for determining the time of setting by Gillmore needles, see Test Method C266.

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.*

¹ These test methods are under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.30 on Time of Set.

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

2. Referenced Documents

2.1 *ASTM Standards*:³

C150/C150M Specification for Portland Cement

C151/C151M Test Method for Autoclave Expansion of Hydraulic Cement

C183/C183M Practice for Sampling and the Amount of Testing of Hydraulic Cement

C187 Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste

C219 Terminology Relating to Hydraulic and Other Inorganic Cements

C266 Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles

C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

C595/C595M Specification for Blended Hydraulic Cements

C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in Physical Testing of Hydraulic Cements

C1157/C1157M Performance Specification for Hydraulic Cement

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this test method, refer to Terminology C219.

4. Summary of Test Method

4.1 A paste that is proportioned and mixed to normal consistency, as described in the Test Method C187, is molded and placed in a moist cabinet and allowed to start setting.

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

Periodic penetration tests are performed on this paste by allowing a 1 mm Vicat needle to settle into this paste. The Vicat initial time of setting is the time elapsed between the initial contact of cement and water and the time when the penetration is measured or calculated to be 25 mm. The Vicat final time of setting is the time elapsed between initial contact of cement and water and the time when the needle does not leave a complete circular impression in the paste surface.

5. Significance and Use

5.1 This test method provides a means of determining compliance with a specification limit for Vicat time of setting. Refer to the appropriate specification for the cement to determine if this test method is used for specification compliance.

5.2 Time of setting measured by this method will not necessarily provide the same results as the time of setting of hydraulic cement paste measured by other methods, or the time of setting of mortar or concrete.

6. Apparatus

6.1 *Vicat Apparatus*—See Annex A1.1 and Fig. A1.1. The Vicat apparatus for this test method shall have a movable rod, B, of mass 300 ± 0.5 g.

6.1.1 The end of the rod used for measuring penetration shall have a straight steel removable needle with a diameter of 1.00 ± 0.05 mm and length no less than 50 mm.

6.1.2 The needle end that contacts the specimen shall be flat, plane, and at right angles to the axis of the rod.

6.2 *Reference Masses and Devices for Determining Mass*, conforming to the requirements of Specification C1005. The devices for determining mass shall be evaluated for continuing precise performance utilizing the procedure in Specification C1005, Appendix X1 using a verification check mass of approximately 1000 g.

6.3 *Glass Graduates*, 200 or 250 mL capacity, and conforming to the requirements of Specification C1005.

6.4 *Plane Non-Adsorptive Plate*, 100 ± 5 mm square of similar planeness, corrosivity, and absorptivity to that of glass (see Annex A1.1, Fig. A1.1, H).

6.5 *Flat Trowel*, having a sharpened straight-edged steel blade 100 to 150 mm in length. The edges when placed on a plane surface shall not depart from straightness by more than 1 mm.

6.6 *Conical Ring*, made of a rigid, non-corroding, non-absorbent material and having a height of 40 ± 1 mm, an inside diameter at the bottom of 70 ± 3 mm, and an inside diameter at the top of 60 ± 3 mm (see Annex A1.1, Fig. A1.1, G).

6.7 *Mixer, Bowl, and Paddle*, conforming to Practice C305.

6.8 *Automatic Vicat Needle Apparatus for Method B*—The apparatus shall be equipped with a Vicat needle as described in 6.1.1 and 6.1.2. The total mass supported by the needle tip at the time of measurement shall be 300 ± 0.5 g. The instrument shall be capable of automatically completing and recording penetration measurements of a test specimen at predetermined

time intervals not exceeding 10 min and make each penetration test at least 5 mm away from any previous penetration and at least 10 mm away from the inner side of the mold.

6.9 *Specimen Mold for Method B*—The cement paste is held in a conical ring with the height of 40 ± 1 mm and a removable base plate. The test surface shall have a minimum diameter of 60 ± 3 mm.

6.10 Inspect and document Section 6 apparatus for conformance to the requirements of this test method at least every 2½ years (see Note 2).

NOTE 2—Specification C1005 requires annual compliance checks for the reference masses and for the devices for determining mass.

7. Reagents and Materials

7.1 *Mixing Water*—Potable water is satisfactory for routine tests. Use reagent water for all referee and cooperative tests.

8. Sampling

8.1 When the test is required for acceptance testing, sample cement in accordance with Practice C183/C183M.

9. Conditioning

9.1 Maintain the temperature and the humidity of the mixing room and the temperature of the mixing water in accordance with Specification C511 (see section titled “Requirements for Cement Mixing Rooms”).

9.2 The moist cabinet or moist room shall be in accordance with Specification C511.

9.3 The dry materials shall be within the temperature range of the mixing room prior to testing.

10. Preparation of Cement Paste

NOTE 3—See Test Method C187.

10.1 The cement paste used for the determination of the time of setting is obtained from one of the following methods:

10.1.1 Prepare a new batch of paste by mixing 650 g of cement with the percentage of mixing water required for normal consistency (Test Method C187), following the procedure described in Practice C305.

10.1.2 For method A, at the option of the tester, use the test specimen used for determining normal consistency (see Note 4).

10.1.3 At the option of the tester, use the paste remaining from the batch used for the autoclave specimen (Test Method C151/C151M) or from the normal consistency determination (Test Method C187).

NOTE 4—The specimen used for the determination of the normal consistency will have an irregular surface, making it unsuitable for method B.

11. Calculation

11.1 Calculate the Vicat time of setting to the nearest 1 min as follows:

$$\left(\left(\frac{H - E}{C - D} \right) \times (C - 25) \right) + E \quad (1)$$