



Designation: C266 – 21

Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles¹

This standard is issued under the fixed designation C266; 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 test method covers the determination of the time of setting of hydraulic-cement paste by means of the Gillmore needles.

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 The text of this standard references 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.

1.4 *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

1.5 *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:³

¹ This test method is 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.

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.

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

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

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

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

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 Sufficient water is added to the cement that is being tested to produce a paste of normal consistency. A specimen is molded from this paste and is tested for time of setting by means of the Gillmore initial and final needles. The initial time of setting is the time elapsed between initial contact of cement and water and the time when the Gillmore Initial needle does not leave a complete circular impression in the paste surface. The final time of setting is the time elapsed between initial contact of cement and water and the time when the Gillmore Final needle does not leave a complete circular impression in the paste surface.

5. Significance and Use

5.1 The purpose of this test method is to establish whether a cement complies with a specification limit on Gillmore time of setting.

*A Summary of Changes section appears at the end of this standard

6. Apparatus

6.1 *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.

6.2 *Mixer, Bowl, Paddle, and Scraper*, conforming to the requirements of Practice **C305**.

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

6.4 *Mass Determining Devices*, 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.

6.5 *Plane Non-absorptive Plates*, 100 ± 5 mm square, of similar planeness, corrosivity, and absorptivity to that of glass (see Test Method **C187** Fig. 1, item H).

6.6 *Gillmore Needles*, conforming to the following requirements:

6.6.1 The initial time of setting needle shall have a mass of 113.4 ± 0.5 g and a tip diameter of 2.12 ± 0.05 mm.

6.6.2 The final time of setting needle shall have a mass of 453.6 ± 0.5 g and a tip diameter of 1.06 ± 0.05 mm.

6.6.3 The needle tips shall be cylindrical for a distance of 4.8 ± 0.5 mm. The needle ends shall be plane and at right angles to the axis of the rod and shall be maintained in a clean condition (see **Note 1**).

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

NOTE 1—The Gillmore needles should preferably be mounted as shown in **Fig. 1**(b).

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

7. Reagents

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 part of acceptance testing, sample the cement in accordance with Practice **C183/C183M**.

9. Conditioning

9.1 Maintain the temperature and humidity of the mixing room and the temperature of the mixing water in accordance with Specification **C511** requirements for cement mixing rooms.

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

9.3 Maintain the moist cabinet or moist room in accordance with the requirements of Specification **C511**.

10. Procedure

10.1 *Preparation of Cement Paste*—Obtain the cement paste used for determination of the time of setting 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 At the option of the tester, use the paste remaining from the batch used for the autoclave expansion specimen (Test Method **C151/C151M**) or from the normal consistency determination (Test Method **C187**).

10.2 *Molding Test Specimen*—From the cement paste prepared as described in **10.1**, make a pat with a flat top and the sides tapering to a thin edge on a plane non-absorptive plate, conforming to the dimensions and tolerances in **Fig. 1**(a). In molding the pat, flatten the cement paste first on the plate and then form the pat by drawing the trowel from the outer edge toward the center, then flattening the top. After making, place the pat in the moist cabinet or moist room and allow it to remain there except when the determinations of time of setting are being made.

10.3 *Time of Setting Determination*—Determine the time of setting by holding the needle in a vertical position and lightly applying it to the surface of the pat.

10.3.1 Using the Initial Gillmore needle, determine the Gillmore Initial time of setting end point to be the first penetration measurement that does not mark the specimen surface with a complete circular impression. Verify Initial set by obtaining two additional penetration measurements on different areas of the specimen surface. Verification measurements must be obtained within 90 s of the first “initial set” measurement. The elapsed time, in minutes, between the time of contact of cement and mixing water and the end point determined above is the Gillmore initial time of setting.

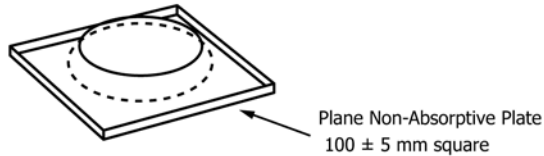
10.3.2 Using the Final Gillmore needle, determine the Gillmore Final time of setting end point to be the first penetration measurement that does not mark the specimen surface with a complete circular impression. Verify Final set by obtaining two additional penetration measurements on different areas of the specimen surface. Verification measurements must be obtained within 90 s of the first “final set” measurement. The elapsed time, in minutes, between the time of contact of cement and mixing water and the end point determined above is the Gillmore final time of setting.

11. Report

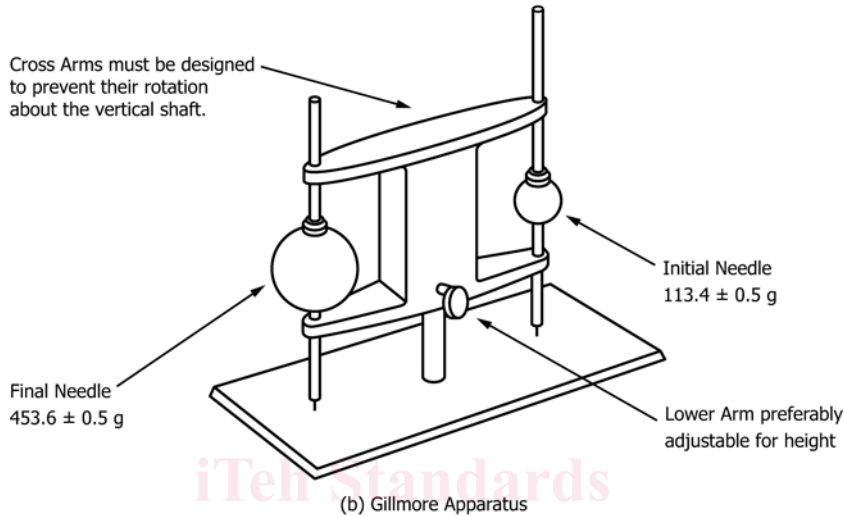
11.1 Report the time of setting, to the nearest 5 min, as follows:

Initial Time of Setting, Gillmore	___ min
Final Time of Setting, Gillmore	___ min

Cement Paste Pat
 Base diameter 76 ± 13 mm
 Top diameter 50 ± 13 mm
 Center thickness 13 ± 3 mm

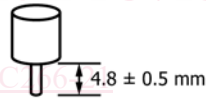


(a) Pat with Top Surface Flattened for Determining Time of Setting by Gillmore Method



(b) Gillmore Apparatus

Replaceable tips may be made of stock drill rod or wire tempered after shaping and held by suitable chuck or other fastener



Tip Diameter
 Initial: 2.12 ± 0.05 mm
 Final: 1.06 ± 0.05 mm

(c) Detail of Gillmore Apparatus Needle Tips

FIG. 1 Gillmore Apparatus and Test Specimen

12. Precision and Bias

12.1 *Precision, Gillmore Initial Time of Setting on Samples Testing Between 100 and 341 min (See Note 3):*

12.1.1 The single-operator (within laboratory) standard deviation has been found to be 16 min (1s), therefore, results of two properly conducted tests by the same operator on samples of the same cement should not differ from each other by more than 44 min (d2s) (1s and d2s are defined in Practice C670).

12.1.2 The multi-laboratory standard deviation has been found to be 28 min (1s), therefore, results of two properly conducted tests from two different laboratories should not differ from each other by more than 78 min (d2s).

12.2 *Precision, Gillmore Final Time of Setting on Samples Testing Between 239 and 561 min (See Note 3):*

12.2.1 The single-operator (within laboratory) standard deviation has been found to be 22 min (1s), therefore, results of

two properly conducted tests by the same operator on samples of the same cement should not differ from each other by more than 62 min (d2s).

12.2.2 The multi-laboratory standard deviation has been found to be 46 min (1s), therefore, results of two properly conducted tests from two different laboratories on samples of the same cement should not differ by more than 129 min (d2s).

12.3 *Bias*—Since an acceptable reference material suitable for determining any bias of this method does not exist, no statement on bias is being made.

NOTE 3—This data is based upon CCRL Portland cement round robin test samples 47 to 138 and CCRL Masonry cement round robin test samples 1 to 46.

13. Keywords

13.1 Gillmore needles; hydraulic cement paste; time of setting