



# Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles<sup>1</sup>

This standard is issued under the fixed designation C 266; 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 ( $\epsilon$ ) 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 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.*

**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.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C 151 Test Method for Autoclave Expansion of Portland Cement
- C 183 Practice for Sampling and the Amount of Testing of Hydraulic Cement
- C 187 Test Method for Normal Consistency of Hydraulic Cement
- C 219 Terminology Relating to Hydraulic Cement
- C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- Cements and Concretes
- C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- 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

## 3. Terminology

- 3.1 Refer to Terminology C 219 for definitions of terms.

## 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 required for the test specimen to bear the initial Gillmore needle without appreciable indentation, while the time required for the test specimen to bear the final Gillmore needle without appreciable indentation is the final time of setting.

## 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.

## 6. Apparatus

- 6.1 *Trowel*, having a steel blade 100 to 150 mm (4 to 6 in.) in length, with a sharpened straight edge.
- 6.2 *Mixer, Bowl, Paddle, and Scraper*, conforming to the requirements of Practice C 305.
- 6.3 *Glass Graduates*, conforming to the requirements of Practice C 1005.
- 6.4 *Mass Determining Devices*, conforming to the requirements of Specification C 1005.
- 6.5 *Plane Non-absorptive Plates*, 102 mm  $\pm$  3 mm (4 in.  $\pm$  0.125 in.) square.
- 6.6 *Gillmore Needles*, conforming to the following requirements:

6.6.1 The initial setting-time needle shall have a weight of  $113.4 \pm 0.5$  g ( $0.250 \pm 0.001$  lb) and a tip diameter of  $2.12 \pm 0.05$  mm ( $0.084 \pm 0.002$  in.).

6.6.2 The final setting time needle shall have a weight of  $453.6 \pm 0.5$  g ( $1.000 \pm 0.001$  lb) and a tip diameter of  $1.06 \pm 0.05$  mm ( $0.042 \pm 0.002$  in.).

6.6.3 The needle tips shall be cylindrical for a distance of  $4.8 \pm 0.5$  mm ( $0.189 \pm 0.020$  in.). The needle ends shall be plane and at right angles to the axis of the rod and shall be maintained in a clean condition. The Gillmore needles should preferably be mounted as shown in Fig. 1 (b).

## 7. Reagents

7.1 *Mixing Water*—Potable water is satisfactory for routine tests. For all referee and cooperative tests, reagent water conforming to the requirements of Specification D 1193 for Type III or Type IV grade of reagent water shall be used.

## 8. Sampling

8.1 When the test is part of acceptance testing, sample the cement in accordance with Practice C 183.

## 9. Conditioning

9.1 Maintain the temperature of the room, dry materials, paddle, bowl, and plane non-absorptive plates at  $23.0 \pm 3.0^\circ\text{C}$ . Maintain the temperature of the mixing water at  $23.0 \pm 2.0^\circ\text{C}$ .

9.2 Maintain the relative humidity of the laboratory at not less than 50%.

9.3 The moist cabinet or moist room shall conform to the requirements of Specification C 511.

## 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 C 187), following the procedure described in Practice C 305.

10.1.2 At the option of the tester, use the paste remaining from the batch used for the autoclave expansion specimen (Test Method C 151) or from the normal consistency determination (Test Method C 187).

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*—In determining the time of setting, hold the needles in a vertical position and apply lightly to the surface of the pat. Consider the cement paste to have acquired its initial set when the pat will bear the initial Gillmore needle without appreciable indentation. The elapsed time, in minutes, between the time of contact of cement and mixing water and the time the cement paste acquires its initial set is the Gillmore initial time of setting. Consider the cement paste to have acquired its final set when the pat will bear the final Gillmore needle without appreciable indentation. The elapsed time, in minutes, between the time of contact of cement and mixing water and the time the cement paste acquires its final set 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

## 12. Precision and Bias

12.1 Precision, Gillmore Initial Time of Setting on samples testing between 100 and 341 min. (See Note 1)

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 C 670).

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 1)

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

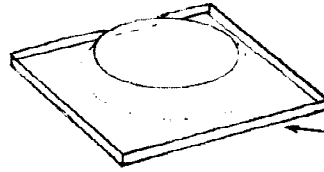
12.3.1 Since an acceptable reference material suitable for determining any bias of this method does not exist, no statement on bias is being made.

NOTE 1—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

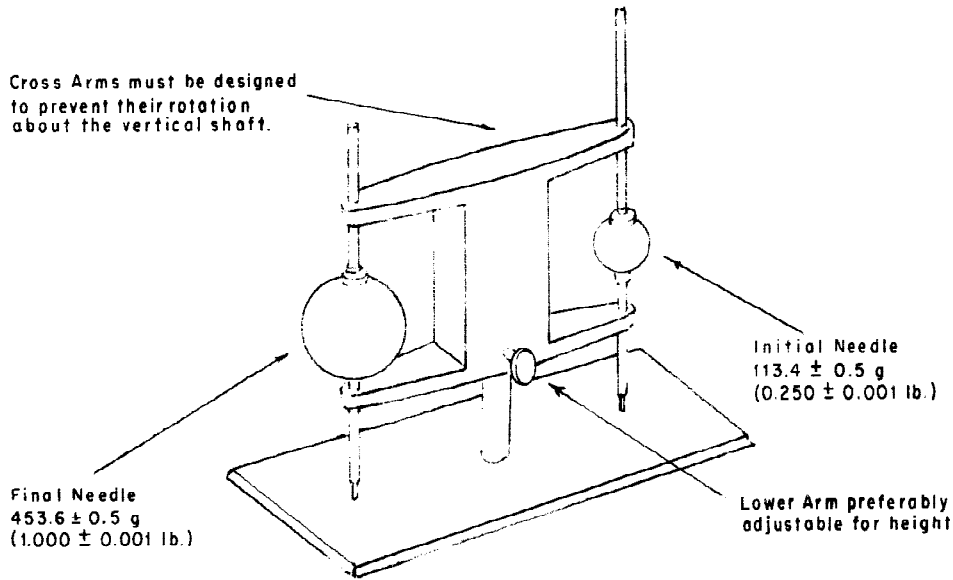
13.1 gillmore needles; hydraulic cement paste; time of setting

Cement Paste Pat  
 Base diameter  $76 \pm 13$  mm  
 ( $3 \pm 0.5$  in.)  
 Top diameter  $50 \pm 13$  mm  
 ( $2 \pm 0.5$  in.)  
 Center thickness  $13 \pm 3$  mm  
 ( $0.5 \pm 0.125$  in.)



Plane Non-Absorptive Plate  
 $102 \pm 3$  mm  
 ( $4 \pm 0.125$  in.) square

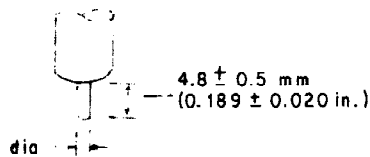
(a) Pat with Top Surface Flattened for Determining Time of Setting by Gillmore Method



(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:  $2.12 \pm 0.05$  mm  
 ( $0.084 \pm 0.002$  in.)  
 Final:  $1.06 \pm 0.05$  mm  
 ( $0.042 \pm 0.002$  in.)



(c) Detail of Gillmore Apparatus Needle Tips  
 FIG. 1 Gillmore Apparatus and Test Specimen

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