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StandardTest Methods for Self-leveling Mortars Containing Hydraulic Cements[1]

This standard is issued under the fixed designation C1708; 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 are appropriate to evaluate the performance of self-leveling mortars containing hydraulic cements that are used to improve the levelness, smoothness, and flatness of existing floors. These materials may be used as an underlayment to receive floor finishes, or as an overlayment to serve as the wear surface. The self-leveling mortars covered by these test methods consist of proprietary blends of hydraulic cements, along with fine aggregate, polymers, fillers, and other additives.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Some values have only SI units because the inch-pound equivalents are not used in practice.

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.[2])

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

C125 Terminology Relating to Concrete and Concrete Aggregates

C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

C191 Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle

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

C348 Test Method for Flexural Strength of Hydraulic-Cement Mortars

C490 Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete

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

C778 Specification for Sand

C928/C928M Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

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

C1107/C1107M Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *flow, n—of self-leveling mortars*, the ability of a freshly-mixed, self-leveling mortar to spread under its own weight.

3.2.2 *healing, n*—the ability of a self-leveling mortar to return to its original state of levelness and smoothness after being disturbed.

3.2.3 *mortar, self-leveling, n*—mortar containing hydraulic cement that, in the fresh state, exhibits flow sufficient to seek gravitational leveling.

3.2.4 *overlayment, n— in flooring*, a layer of material usually placed upon the sub-floor that provides a smooth, even surface to be left exposed as the wear surface of the floor.

3.2.5 *time, healing, n*—the period of time from initial contact of a self-leveling mortar with mixing water just prior to

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[2] Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol 04.02.

[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.

the time at which the self-leveling mortar no longer heals but instead leaves a visible indentation or ridge in the surface after being disturbed.

3.2.6 *time, starting, n—of self-leveling mortars*, the time when water is brought into contact with the dry ingredients of a self-leveling mortar.

3.2.7 *underlayment, n— in flooring*, a layer of material usually placed upon the sub-floor that provides a smooth, even base for flooring.

4. Significance and Use

4.1 The test methods in this standard are used to evaluate freshly mixed properties such as the initial flow, flow retention, and healing time as well as hardened properties such as compressive strength, setting time, and flexural strength, of self-leveling mortars.

4.2 Tests are conducted under standardized conditions for comparative purposes and results are not intended to be representative of performance under field conditions.

5. Standard Laboratory Conditions

5.1 Unless otherwise specified, curing and testing of specimens shall be conducted at standard laboratory conditions which are defined as 23.0 ± 2.0 ºC [73.5 ± 3.5 ºF] and the relative humidity of the laboratory shall be not less that 50 %. For optional tests at the manufacturer's stated temperature extremes, the curing and testing temperatures must be within ±2.0 °C [±3.5 °F] of the stated extreme temperatures.

6. Sampling

6.1 Sample according to the Sampling section of Specification C1107/C1107M.

7. Mixing

7.1 *Apparatus:*

7.1.1 Use the mixer and scraper as specified in Practice C305. The standard batch size is 3000 g (See Note 1) of dry self-leveling mortar. Use a splash guard to prevent excessive splashing.

Warning—The clearances between the paddle and the bowl specified in Practice C305 are suitable when using mortar made with standard sand as described in Specification C778. To permit the mixer to operate freely and to avoid serious damage to the paddle and bowl when coarser aggregates are used, it may be necessary to set the clearance adjustment bracket to provide greater clearances than those specified in 4.1 of Practice C305.

7.1.2 Weighing devices used in determining the mass of materials shall conform to Specification C1005.

7.1.3 A timer accurate to 1 s with a range of at least 60 min.

NOTE 1—This batch size is used for self-leveling mortars with a typical freshly mixed density of approximately 1920 kg/m^3 [120 lb/ft^3]. Adjust the batch size as needed to accommodate densities significantly different from the typical value.

7.2 *Procedure:*

7.2.1 Mix the self-leveling mortar with liquid as prescribed by the manufacturer. In the absence of manufacturer's instructions the liquid content shall be adjusted to achieve an initial flow of 125 to 150 mm [5 to 6 in.] as per 8.4.

NOTE 2—Water is the most common mixing liquid although latex admixtures or other liquids may be recommended by some manufacturers.

7.2.2 Add the entire quantity of mixing liquid to the bowl. Start the mixer on speed 1 and start the timer. Mix times are to be observed within ±5 s of the recommended times.

7.2.3 Add the dry self-leveling mortar to the mixer while mixing at speed 1 during the first 30 s. (0-30 s on timer)

7.2.4 Mix for an additional 30 s period, at speed 1. (30-60 s on timer)

7.2.5 Stop the mixer and quickly scrape down into the batch any mortar that may have collected on the side of the bowl or blade. This must be completed within 30 s (60-90 s on timer)

7.2.6 Mix at speed 2 for 240 s. (90-330 s on timer)

7.2.7 In any case requiring a remixing interval, any mortar adhering to the side of the bowl shall be quickly scraped down into the batch with the scraper prior to remixing.

8. Initial Flow, Flow Retention, and Healing Time

8.1 *Scope*—This test method measures the flow of freshly-mixed, self-leveling mortar by releasing it from a rigid tube after a given time. The diameter of the spread mixture is measured after a specified time. Flow retention is measured by repeating the test on aged material. Healing time is determined by making specific cuts in the surface of the self-leveling mortar at regular time intervals and determining the latest time for which the mortar will still heal as evaluated after setting.

8.2 *Significance and Use*—The flow of a self-leveling mortar is a measure of its placeability. Establishing an acceptable flow range for the self-leveling mortar is critical to the proper use of the self-leveling mortar. If the flow is too low, the self-leveling mortar will not be self-leveling and if the flow is too high, the designed properties of the self-leveling mortar will be compromised. A proper flow range must be established in order to determine the proper water content to use when evaluating the physical properties of the mortar. The flow retention and healing time provide an indication of the useful working time of the mortar.

8.3 *Apparatus:*

8.3.1 Flow Ring: A tube made of smooth, non-corrosive material of 30.0 ± 0.1mm [1¼ ± 1⁄16 in.] internal diameter and 50.0 ± 0.1 mm [2 ± 1⁄16 in.] high.

8.3.2 A clean, dry 400 × 400 × 6 mm [16 in. × 16 in. × ¼ in.] square glass plate.

8.3.3 A timer accurate to 1 s with a range of at least 60 min.

8.3.4 A length-measuring device such as a ruler or tape measure divided into 1 mm [1⁄16 in.] divisions at least 300 mm [12 in.] long.

8.3.5 Rectangular pan with inside dimensions of at least 210 mm × 210 mm [8½ × 8½ in.] with a nominal depth of at least 9 mm [⅜ in.] made of metal or glass not attacked by the self-leveling mortar.

8.3.6 A metal bar 6 mm [¼ in.] thick, with square edges, and at least 150 mm [6 in.] long.

NOTE 3—The side of a mold used to prepare specimens for Test Method C157/C157M is acceptable for this purpose.

8.4 *Procedure:*

8.4.1 *Initial Flow:*

8.4.1.1 Place the flow ring centrally on the glass plate and place this assembly on a firm horizontal surface not to depart from horizontal by more than 0.5° (approximately equivalent to 1 mm in 100 mm [0.12 in. in 12 in.]).

8.4.1.2 Within 30 s from the completion of mixing, completely fill the flow ring, immediately lift the flow ring and simultaneously start the timer. Lift the flow ring from the glass plate in a vertical direction to a height of 50 to 100 mm [2 to 4 in.] within 2 s and allow the material to empty from the ring onto the glass plate.

8.4.1.3 Allow the mortar to spread for 240 ± 10 s and measure the diameter of the spread in two directions at right angles using the length-measuring device. Record the average diameter as the initial flow of the self-leveling material.

8.4.1.4 Report the initial flow, mm [in.].

8.4.2 *Flow Retention:*

8.4.2.1 Repeat the flow test at 20 min and 30 min from the starting time and record the flow. Remix the material by using the Practice C305 mixer, speed 1, for 5 to 10 s before filling the flow ring.

8.4.2.2 Report the flow retention as the flow, mm [in.] at 20 min and 30 min.

NOTE 4—Self-leveling mortars with flow retention times either shorter or longer than 20-30 min reported in 8.4.2.2 may be measured at appropriate 10 min intervals until material no longer flows out of the flow ring.

NOTE 5—An alternate procedure for flow retention is to fill three flow rings after the completion of mixing. The first ring is lifted immediately and the second and third rings are lifted at 20 min and 30 min respectively from the starting time. This procedure is not recommended as the primary method of measuring flow retention but may be used to provide additional information about the behavior of the material in a completely undisturbed condition. The precision of this method is included in section 10.1.2.1 (2).

8.4.3 *Healing Time:*

8.4.3.1 Place the pan on a level, vibration free surface.

8.4.3.2 Upon completion of mixing, pour self-leveling mortar into the pan until a thickness of 6 ±1 mm [¼ ± 1/16 in.] is obtained.

8.4.3.3 Start making a full-depth cut in the test specimen at 10 min from the starting time using the 6 mm [¼ in.] thick metal bar (See Fig. 1). Hold the bar at approximately a 45° angle. Start at the far side of the pan about 25 mm [1 in.] from the left edge of the pan. Pull the bar smoothly through the mix stopping at the near edge of the pan. Complete the cut in approximately 5 to 10 s. Record the time of the beginning of each cut from the defined starting time.

8.4.3.4 Continue making cuts every 5 min until the material no longer heals. Each cut shall be made about 25 mm [1 in.] to the right of the previous cut.

8.4.3.5 Allow the specimen to cure overnight before rating healing time.

8.4.3.6 Healing time is determined by both touching and observing the cuts made the previous day. If there is an obvious ridge or indentation in the cut, the material is not healing (see definition). Make observations near the center of the cuts avoiding areas near the edge of the pan.

8.4.3.7 Report the healing time as the longest time for which no obvious indentation or ridge is observed.

9. Physical Properties

9.1 The following test methods are used to characterize the time of setting, strength and dimensional stability of the self-leveling mortar and will require several batches to complete the testing. In order to ensure valid comparisons, all tests shall be conducted at the same liquid content using the amount and type of liquid prescribed by the manufacturer (see Note 2). In the absence of manufacturer's instructions the correct liquid content shall be established by using an initial trial batch for that purpose. Liquid content shall be adjusted to achieve a flow of 125 to 150 mm [5 to 6 in.]. The trial batch shall not be used for specimen preparation. It will then be necessary to mix additional batches of material using the same amount of liquid as was established by the trial batch. Always use freshly mixed material for each test.

FIG. 1 Full-Depth Cut in Test Specimen