Standard Method of Test for

Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)

AASHTO Designation: T 106M/T 106-21

Technically Revised: 2021 **Editorially Revised: 2021**

Technical Subcommittee: 3a, Hydraulic Cement and Lime

ASTM Designation: C109/C109M-21

AASHTO

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1. SCOPE

1.1. This test method covers determination of the compressive strength of hydraulic cement mortar using 50-mm [or 2-in.] cube specimens (see Note 1).

Note 1—ASTM C349 provides an alternative procedure for this determination (not to be used for acceptance tests).

1.2. This test method covers the application of the test using either inch-pound or SI units. The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in brackets. 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 nonconformance with the standard.

1.3. Values in SI units shall be obtained by measurement in SI units or by appropriate conversion, using the Rules for Conversion and Rebounding given in Standard IEEE/ASTM SI 10, of measurements made in other units.

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 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.

1.5. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 85, Portland Cement
- M 152M/M 152, Flow Table for Use in Tests of Hydraulic Cement

- M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- M 240M/M 240, Blended Hydraulic Cement
- M 295, Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- M 302, Slag Cement for Use in Concrete and Mortars
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- T 105, Chemical Analysis of Hydraulic Cement
- T 162, Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

2.2. *ASTM Standards*:

- C91/C91M, Standard Specification for Masonry Cement
- C349, Standard Test Method for Compressive Strength of Hydraulic-Cement Mortars (Using Portions of Prisms Broken in Flexure)
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C778, Standard Specification for Standard Sand
- C1005, Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements
- C1157/C1157M, Standard Performance Specification for Hydraulic Cement
- C1328/C1328M, Standard Specification for Plastic (Stucco) Cement
- C1329/C1329M, Standard Specification for Mortar Cement

2.3. *IEEE/ASTM Standard*:

- SI10, American National Standard for Metric Practice

3. SUMMARY OF TEST METHOD

3.1. The mortar used consists of one part cement and 2.75 parts of sand proportioned by mass. Portland, air-entraining portland, portland-limestone, or air-entrained portland-limestone cements are mixed at a specified water content. Water content for other cements is that sufficient to obtain a flow of 110 ± 5 in 25 drops of the flow table. Fifty-millimeter [or 2-in.] test cubes are compacted by tamping in two layers. The cubes are cured 24 h in the molds, and then stripped and immersed in lime water until tested.

4. SIGNIFICANCE AND USE

4.1. This test method provides a means of determining the compressive strength of hydraulic cement and other mortars, and results may be used to determine compliance with specifications. Further, this test method is referenced by numerous other specifications and test methods. Caution must be exercised in using the results of this test method to predict the strength of concretes.

5. APPARATUS

5.1. *Weights and Weighing Devices*—Shall conform to the requirements of ASTM C1005. The weighing device shall be evaluated for precision and accuracy at a total load of 2000 g.

5.2. *Glass Graduates*—Of suitable capacities (preferably large enough to measure the mixing water in a single operation) to deliver the indicated volume at 20°C. The permissible variation shall be

±2 mL. These graduates shall be subdivided to at least 5 mL, except that the graduation lines may be omitted for the lowest 10 mL for a 250-mL graduate and for the lowest 25 mL for a 500-mL graduate. The main graduation lines shall be circles and shall be numbered. The least graduations shall extend at least one-seventh of the way around, and intermediate graduations shall extend at least one-fifth of the way around.

5.3. *Specimen Molds*—For the 50-mm [or 2-in.] cube specimens shall be tight fitting. The molds shall have no more than three cube compartments and shall be separable into no more than two parts. The parts of the molds when assembled shall be positively held together. The molds shall be made of hard metal not attacked by the cement mortar. For new molds, the Rockwell hardness number of the metal shall be not less than 55 HRB. The sides of the molds shall be sufficiently rigid to prevent spreading or warping. The interior faces of the molds shall be plane surfaces and shall conform to the tolerances of Table 1.

Table 1—Permissible Variations of Specimen Molds

	50-mm Cube Molds		2-in. Cube Molds	
Parameter	New	In Use	New	In Use
Planeness of sides	<0.025 mm	<0.05 mm	<0.001 in.	<0.002 in.
Distance between opposite sides	50 mm ± 0.13 mm	50 mm ± 0.50 mm	2 in. ± 0.005	2 in. ± 0.02
Height of each compartment	50 mm + 0.25 mm to – 0.13 mm	50 mm + 0.25 mm to – 0.38 mm	2 in. + 0.01 in. to – 0.005 in.	2 in. + 0.01 in. to – 0.015 in.
Angle between adjacent faces[a]	90 ± 0.5°	90 ± 0.5°	90 ± 0.5°	90 ± 0.5°

[a] Measured at points slightly removed from the intersection. Measured separately for each compartment between all the interior faces and the adjacent face and between interior faces and top and bottom planes of the mold.

5.4. *Mixer, Bowl, and Paddle*—An electrically driven mechanical mixer of the type equipped with paddle and mixing bowl, as specified in T 162.

5.5. *Flow Table and Flow Mold*—Conforming to the requirements of M 152M/M 152.

5.6. *Tamper*—A nonabsorptive, nonabrasive, nonbrittle material such as a rubber compound having a Shore A durometer hardness of 80 ± 10 or seasoned oak wood rendered nonabsorptive by immersion for 15 min in paraffin at approximately 200°C [392°F], shall have a cross section of 13 by 25 mm [$^1/_2$ by 1 in.] and a convenient length of about 120 to 150 mm [5 to 6 in.]. The tamping face shall be flat and at right angles to the length of the tamper.

5.6.1. Tampers shall be checked for conformance to the design and dimensional requirements of this test method at least once every six months.

Note 2—A visual inspection of the tamper should be performed each day before use to confirm that the end is flat and at a right angle to the long axis of the tamper. Rounded or peeling tampers should not be used.

5.7. *Trowel*—Having a steel blade 100 to 150 mm [4 to 6 in.] in length, with straight edges.

5.8. *Moist Cabinet or Room*—Conforming to the requirements of M 201.

5.9. *Testing Machine*—Either the hydraulic or the screw type, with sufficient opening between the upper bearing surface and the lower bearing surface of the machine to permit the use of verifying apparatus. The load applied to the test specimen shall be indicated with an accuracy of ±1.0 percent. If the load applied by the compression machine is registered on a dial, the dial shall be provided with a graduated scale that can be read to at least the nearest 0.1 percent of the full scale load (see Note 3). The dial shall be readable within 1 percent of the indicated load at any given