Designation: C495/C495M – 12

Standard Test Method for Compressive Strength of Lightweight Insulating Concrete[1]

This standard is issued under the fixed designation C495/C495M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers the preparation of specimens and the determination of the compressive strength of lightweight insulating concrete having an oven-dry density not exceeding 800 kg/m^3 [50 lb/ft^3] as determined by the procedures described herein. This test method covers the preparation and testing of molded 75 by 150-mm [3 by 6-in.] cylinders.

1.2 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.

1.3 *This standard does not purport to address all of the safety problems, 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

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

C172 Practice for Sampling Freshly Mixed Concrete

C617 Practice for Capping Cylindrical Concrete Specimens

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

3. Significance and Use

3.1 This test method provides standardized requirements for sampling, molding, curing, and testing lightweight insulating concretes for the purpose of determining compliance with compressive strength and density specifications.

4. Apparatus

4.1 *Testing Machine*—Use a testing machine as prescribed in Test Method C39/C39M.

4.2 *Scales and Weights*—Use scales and weights in weighing specimens that conform to those specified in the Apparatus Section of Test Method C109/C109M.

4.3 *Drying Oven*—Use an oven as specified in Test Method C88.

4.4 *Molds*—Use molds made of nonabsorbent materials or of materials treated to reduce absorption, that are watertight, and not subject to distortion of more than 2 mm [1⁄16 in.] in any dimension during molding and early curing of specimens. Coat all mold surfaces that will be in contact with concrete except single use plastic molds with wax or mineral oil, prior to use. Use molds having a diameter of 75 ± 2 mm [3 ± 1⁄16 in.] and a length of 150 ± 3 mm [6 ± 1⁄8 in.].

5. Sampling

5.1 Sample fresh lightweight insulating concrete in accordance with applicable provisions of Practice C172, with the following exceptions:

5.1.1 *Sampling from Pump Equipment*—Fill a bucket of approximately 9-L [10-qt] capacity by passing through the discharge stream of the concrete pump hose being used to place the concrete, at the point of placement of the concrete. Exercise care to ensure that the sample is representative of the pour, avoiding the beginning or ending of the discharge from the equipment. Prepare the test specimens as described in Section 6, by filling them with a scoop of lightweight insulating concrete dipped from the bucket.

5.1.2 *Remixing Sample*—Do not remix the sample.

6. Test Specimens

6.1 *Size and Shape*—Use cylindrical test specimens 75 ± 2 mm [3 ± 1⁄16 in.] in diameter and 150 ± 3 mm [6 ± 1⁄8 in.] in

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[2] 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**

length, with the base of each specimen perpendicular to the longitudinal axis within the limits prescribed in 6.8.

6.2 *Number*—The compressive strength of the sample shall be based on the average strength of four cylinders. Obtain at least four test cylinders for compressive strength tests from each sample of lightweight insulating concrete.

6.3 *Molding*—In molding the specimens, place the concrete in two approximately equal layers. Tap the outside of the mold lightly 10 to 15 times with an open hand after placing each layer to close voids and release entrapped air. Over fill the mold when placing the second layer. Do not rod the concrete.

6.4 *Finishing Surface*—Strike off the specimens immediately after filling the molds. Cover them in such a manner as to prevent evaporation without marring the surface (Note 1). If desired, cover the filled mold with a glass or metal plate to obtain a surface that will be suitable for testing without capping and with a minimum of grinding.

NOTE 1—It is desirable to place the filled mold in a moist room if one is available. If this is done, protect the surface from dripping water.

6.5 *Removal from Molds*—Do not remove specimens from molds until danger of damage to the specimens is past. In any event, remove specimens from the molds within 7 days after molding.

6.6 *Curing*—For the first 24 h after molding, maintain the specimens at a temperature of 21 ± 6 °C [70 ± 10 °F]. After 24± 2 h, store the specimens in a moist condition (Note 2) at a temperature of 23.0 ± 2.0 °C [73.5 ± 3.5 °F] (Note 3). Do not expose specimens to a stream of running water nor store in water, unless a saturated lime (calcium hydroxide) solution is used. After 7 days, store the specimens at a temperature of 21 ± 6 °C [70 ± 10 °F] and a relative humidity of 50 ± 30 % for 18 days. Twenty-five days after molding, dry the specimens in an oven at 60 ± 3 °C [140 ± 5 °F] for 3 days (Note 4). Cool specimens to room temperature and test for compressive strength at an age of 28 days. If cellular concrete made using preformed foam is being tested, moist cure the cylinders from day 2 to day 25. At day 25 air dry the cylinders for 3 days at a temperature of 21 ± 6 ºC [70 ± 10 ºF] and a relative humidity of 50 ± 10 %. Do not oven dry the specimens prior to load testing.

NOTE 2—A moist condition is that in which free water is maintained on the surfaces of the specimens at all times.

NOTE 3—The temperature within damp sand and under wet burlap or similar materials will always be lower than the temperature in the surrounding atmosphere if evaporation takes place.

NOTE 4—Caution must be observed in loading the oven so that the moisture content of the specimen at time of test does not exceed 5 % of the oven-dry density determined in accordance with 9.1.

6.7 *Preparation for Testing*—Check whether the surfaces of the specimen that will be in contact with the bearing surfaces of the testing machine are within 0.5 mm [0.02 in.]. If the bearing surfaces depart from a plane more than 0.5 mm [0.02 in.], grind them to conform to this tolerance or cap in accordance with Practice C617. Cap surfaces to be plane within 0.05 mm [0.002 in.]. Check the planeness of the bearing surface of the specimen by means of a straightedge and feeler gage, making a minimum of three measurements on different diameters of the specimen. Make sure the surface of the specimen in contact with the lower bearing block of the testing machine does not depart from perpendicularity with the longitudinal axis of the cylinder by more than 1° (approximately equivalent to 2.5 mm in 150 mm [0.1 in. in 6 in.]) or the combined departure of the two bearing surfaces from perpendicularity by more than 3°.

6.8 *Measurement of Specimen*—Determine the diameter of the specimens to the nearest 0.2 mm [0.01 in.] by averaging two diameters measured at right angles to each other at about midheight of the specimen. Use these dimensions in computing the cross-sectional areas. Determine the height of the specimen to the nearest 0.2 mm [0.01 in.]. Weigh the cylinders before capping and calculate the density from the measured dimensions. Record the density to the nearest 10 kg/m^3 [0.5 lb/ft^3].

7. Procedure

7.1 *Placing of Specimen*—Wipe clean the bearing faces of the upper and lower bearing blocks of the compression test machine and of the test specimen and place the test specimen on the lower bearing block. Carefully align the axis of the specimen with the center of thrust of the spherically seated block. As the spherically seated block is brought to bear on the specimen, gently rotate its movable portion by hand so that uniform seating is obtained.

7.2 *Rate of Loading*—Continuously apply the load without shock at a constant rate such that the maximum load will be reached in 65 ± 15 s. Record the maximum load sustained by the specimen. Note the type of failure and the appearance of the concrete.

8. Calculation

8.1 Calculate the unit compressive strength of the concrete by dividing the maximum load by the average cross-sectional area and record to the nearest 0.1 MPa [10 psi].

9. Oven-Dry Density

9.1 When the oven-dry unit density is desired, mold two companion specimens for this purpose at the same time as the compressive strength specimens. Cure the companion specimens the same as the compressive strength specimens, except dry the companion specimens at the age of 28 days in an oven at 110 ± 5 °C [230 ± 10 °F] and weigh at 24-h intervals until the loss in weight does not exceed 1 % in a 24-h period. Determine the mass and dimensions of the oven-dry specimens and calculate the density from the average data obtained.

10. Report

10.1 For each specimen tested report the following information where applicable:

10.1.1 Identification number,

10.1.2 Cylinder density reported to nearest 10 kg/m^3 [0.5 lb/ft^3].

10.1.3 Dimensions of test specimen, in mm [in.],

10.1.4 The cross-sectional area in mm^2 [in.^{2}],

10.1.5 Type of cap,

10.1.6 Maximum load, in kN [lb],

10.1.7 Unit compressive strength shall be reported as the average of testing four cylinders from the same batch of lightweight insulating concrete defined in 6.2, in MPa [psi],

10.1.8 Type of fracture and appearance of the concrete following determination of compressive strength,

10.1.9 Defects in either specimen or caps,

10.1.10 Age of specimen, in days,

10.1.11 Calculated oven-dry density, if determined,

10.1.12 Average ambient temperature and average relative humidity at which specimens were stored during the 18-day curing period, and

10.1.13 Summation of tests of specimens from same sample with average of test results. This summation shall be shown on the report of the last specimen tested and should be referenced in reports of other specimens.

11. Precision and Bias

11.1 *Precision:*

11.1.1 The single operator standard deviation for a test result (where a test result is, as defined in this test method, the average of four separate compressive strength measurements) has been found to be 0.14 MPa [21 psi] (Notes 5 and 6). Therefore, results of two properly conducted tests (each consisting of the average of four individual measurements) by the same operator on concrete samples from the same batch should not differ by more than 0.41 MPa [59 psi] (Note 6). The range (difference between highest and lowest) of the four individual measurements used in calculating the average should not exceed 1.07 MPa [155 psi] (Note 7).

11.1.2 The multilaboratory standard deviation for a test result has been found to be 0.20 MPa [29 psi] (Note 6). Therefore, results of two properly conducted tests (each consisting of the average of four individual measurements) by two different laboratories on concrete samples from the same batch should not differ by more than 0.57 MPa [83 psi] (Note 6).

NOTE 5—The data used to develop the precision statement were obtained using the previous inch-pound version of this test method. The precision indices are exact conversions of the values shown in brackets.

NOTE 6—These numbers represent, respectively, the (1s) and (d2s) limits as described in Practice C670.

NOTE 7—Calculated as described in 3.4.3 of Practice C670.

11.2 *Bias*—The bias of this test method cannot be determined because compressive strength can only be defined in terms of this test method.

12. Keywords

12.1 compressive strength; density; lightweight insulating concrete; oven-dry density

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C495–07, that may impact the use of this test method. (Approved April 1, 2012)

(*1*) Revised the standard as a combined units test method.
(*2*) Revised 6.2 and 10.1.7 to clarify that four cylinders shall be obtained from the same batch of concrete and the compressive strength of that sample is the average of the four cylinders.
(*3*) The tapping procedure in 6.3 was revised.
(*4*) Added requirement in 6.6 that cellular concrete cylinders be moist cured for 23 days and not be oven dried prior to compressive strength testing.
(*5*) Added requirement in 6.8 to weight cylinders and calculate their density.
(*6*) Added 10.1.7 to require reporting the density.
(*7*) Added new Note 5 to clarify how the precision values were obtained and renumbered subsequent notes.