



*Standard Specification
for*

Sampling and Testing Brick

AASHTO DESIGNATION: T 32-96

AASHTO T 32-96 is based on ASTM C 67-94, but contains only such portions of C 67 as are required for testing brick for conformance to AASHTO Standard Specifications M 91 and M 114. Sections of C 67 that do not pertain to testing brick have not been adopted by AASHTO.



Designation: C 67 - 94

American Association State Highway and Transportation
Officials' Standard
AASHTO No.: T 32-7

Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile¹

This standard is issued under the fixed designation C 67; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 These test methods cover procedures for the sampling and testing of brick and structural clay tile. Although not necessarily applicable to all types of units, tests include modulus of rupture, compressive strength, absorption, saturation coefficient, effect of freezing and thawing, efflorescence, initial rate of absorption and determination of weight, size, warpage, length change, and void area. (Additional methods of test pertinent to ceramic glazed facing tile are included in Specification C 126.)

1.2 *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.*

2. Referenced Documents

2.1 ASTM Standards:

- C 43 Terminology of Structural Clay Products²
- C 126 Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units²
- C 150 Specification for Portland Cement³
- E 4 Practices for Force Verification of Testing Machines⁴
- E 6 Terminology Relating to Methods of Mechanical Testing⁴

3. Terminology

3.1 Definitions:

3.1.1 Terminology E 6 and Terminology C 43 shall be considered as applying to the terms used in these test methods.

4. Sampling

4.1 *Selection of Test Specimens*—For the purpose of these tests, full-size brick, tile, or solid masonry units shall be selected by the purchaser or by his authorized representative. Specimens shall be representative of the whole lot of units from which they are selected and shall include specimens representative of the complete range of colors, textures and sizes in the shipment and shall be free of dirt, mud, mortar,

or other foreign materials unassociated with the manufacturing process.

4.2 Number of Specimens:

4.2.1 *Brick*—For the modulus of rupture, compressive strength, abrasion resistance, and absorption determinations, at least ten individual brick shall be selected for lots of 1 000 000 brick or fraction thereof. For larger lots, five additional specimens shall be selected from each additional 500 000 brick or fraction thereof. Additional specimens may be taken at the discretion of the purchaser.

4.2.2 *Structural Clay Tile*—For the weight determination and for compressive strength and absorption tests, at least five tile shall be selected from each lot of 250 tons (226.8 Mg) or fraction thereof. For larger lots, five additional specimens shall be tested for each 500 tons (453.6 Mg) or fraction thereof. In no case shall less than five tile be taken. Additional specimens may be taken at the discretion of the purchaser.

4.3 *Identification*—Each specimen shall be marked so that it may be identified at any time. Markings shall cover not more than 5 % of the superficial area of the specimen.

4.4 Weight Determination:

4.4.1 *Drying*—Dry the test specimens in a ventilated oven at 230 to 239°F (110 to 115°C) for not less than 24 h and until two successive weighings at intervals of 2 h show an increment of loss not greater than 0.2 % of the last previously determined weight of the specimen.

4.4.2 *Cooling*—After drying, cool the specimens in a drying room maintained at a temperature of 75 ± 15°F (24 ± 8°C), with a relative humidity between 30 and 70 %. Store the units free from drafts, unstacked, with separate placement, for a period of at least 4 h. Do not use specimens noticeably warm to the touch for any test requiring dry units.

4.4.2.1 An alternative method of cooling the specimens to approximate room temperature may be used as follows: Store units, unstacked, with separate placement, in a ventilated room for a period of 4 h, with a current of air from an electric fan passing over them for a period of at least 2 h.

4.4.3 Calculations and Report:

4.4.3.1 Calculate the weight per unit area of a specimen by dividing the total weight in pounds by the average area in square feet of the two faces of the unit as normally laid in a wall.

4.4.3.2 Report results separately for each unit with the average for five units or more.

4.5 *Removal of Silicone Coatings from Brick Units*—The silicone coatings intended to be removed by this process are any of the various polymeric organic silicone compounds used for water-resistant coatings of brick units. Heat the brick at 950 ± 50°F (510 ± 10°C) in an oxidizing atmosphere

¹ These test methods are under the jurisdiction of Committee C-15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Clay Brick and Structural Clay Tile.

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² Annual Book of ASTM Standards, Vol 04.05.

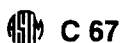
³ Annual Book of ASTM Standards, Vol 04.01.

⁴ Annual Book of ASTM Standards, Vol 03.01.



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for a period of not less than 3 h. The rate of heating and cooling shall not exceed 300°F (149°C) per h.

5. Modulus of Rupture (Flexure Test)

5.1 Test Specimens—The test specimens shall consist of whole dry full-size units (see 4.4.1). Five such specimens shall be tested.

5.2 Procedure:

5.2.1 Support the test specimen flatwise unless specified and reported otherwise (that is, apply the load in the direction of the depth of the unit) on a span approximately 1 in. (25.4 mm) less than the basic unit length and loaded at midspan. If the specimens have recesses (panels or depressions) place them so that such recesses are on the compression side. Apply the load to the upper surface of the specimen through a steel bearing plate ¼ in. (6.35 mm) in thickness and 1½ in. (38.10 mm) in width and of a length at least equal to the width of the specimen.

5.2.2 Make sure the supports for the test specimen are free to rotate in the longitudinal and transverse directions of the test specimen and adjust them so that they will exert no force in these directions.

5.2.3 Speed of Testing—The rate of loading shall not exceed 2000 lbf (8896 N)/min. but this requirement may be considered as being met if the speed of the moving head of the testing machine immediately prior to application of the load is not more than 0.05 in. (1.27 mm)/min.

5.3 Calculation and Report:

5.3.1 Calculate the modulus of rupture of each specimen as follows:

$$S = 3W(l/2 - x)/bd^2$$

where:

S = modulus of rupture of the specimen at the plane of failure, lb/in.² (Pa),

W = maximum load indicated by the testing machine, lbf (N),

l = distance between the supports, in. (mm),

b = net width, (face to face minus voids), of the specimen at the plane of failure, in. (mm),

d = depth, (bed surface to bed surface), of the specimen at the plane of failure, in. (mm), and

x = average distance from the midspan of the specimen to the plane of failure measured in the direction of the span along the centerline of the bed surface subjected to tension, in. (mm).

5.3.2 Report the average of the modulus of rupture determinations of all the specimens tested as the modulus of rupture of the lot.

6. Compressive Strength

6.1 Test Specimens:

6.1.1 Brick—The test specimens shall consist of dry half brick (see 4.4.1), the full height and width of the unit, with a length equal to one half the full length of the unit ±1 in. (25.4 mm), except as described below. If the test specimen, described above, exceeds the testing machine capacity, the test specimens shall consist of dry pieces of brick, the full height and width of the unit, with a length not less than one quarter of the full length of the unit, and with a gross cross-sectional area perpendicular to bearing not less than 14

in.² (90.3 cm²). Test specimens shall be obtained by any method that will produce, without shattering or cracking, a specimen with approximately plane and parallel ends. Five specimens shall be tested.

6.1.2 Structural Clay Tile—Test five dry tile specimens in a bearing bed length equal to the width ± 1 in. (25.4 mm); or test full-size units.

6.2 Capping Test Specimens:

6.2.1 All specimens shall be dry and cool within the meaning of 4.4.1 and 4.4.2 before any portion of the capping procedure is carried out.

6.2.2 If the surface which will become bearing surfaces during the compression test are recessed or paneled, fill the depressions with a mortar composed of 1 part by weight of quick-hardening cement conforming to the requirements for Type III cement of Specification C 150, and 2 parts by weight of sand. Age the specimens at least 48 h before capping them. Where the recess exceeds ½ in. (12.7 mm), use a brick or tile slab section or metal plate as a core fill. Cap the test specimens using one of the two procedures described in 6.2.3 and 6.2.4.

6.2.3 Gypsum Capping—Coat the two opposite bearing surfaces of each specimen with shellac and allow to dry thoroughly. Bed one of the dry shellacked surfaces of the specimen in a thin coat of neat paste of calcined gypsum (plaster of paris) that has been spread on an oiled nonabsorbent plate, such as glass or machined metal. The casting surface plate shall be plane within 0.003 in. (0.076 mm) in 16 in. (406.4 mm) and sufficiently rigid; and so supported that it will not be measurably deflected during the capping operation. Lightly coat it with oil or other suitable material. Repeat this procedure with the other shellacked surface. Take care that the opposite bearing surfaces so formed will be approximately parallel and perpendicular to the vertical axis of the specimen and the thickness of the caps will be approximately the same and not exceeding ⅛ in. (3.18 mm). Age the caps at least 24 h before testing the specimens.

NOTE 1—A rapid-setting industrial type gypsum, such as Hydrocal or Hydrostone, is frequently used for capping.

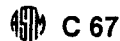
6.2.4 Sulfur-Filler Capping—Use a mixture containing 40 to 60 weight % sulfur, the remainder being ground fire clay or other suitable inert material passing a No. 100 (150-μm) sieve with or without plasticizer. The casting surface plate requirements shall be as described in 6.2.3. Place four 1-in. (25.4-mm) square steel bars on the surface plate to form a rectangular mold approximately ½ in. (12.7 mm) greater in either inside dimension than the specimen. Heat the sulfur mixture in a thermostatically controlled heating pot to a temperature sufficient to maintain fluidity for a reasonable period of time after contact with the surface being capped. Take care to prevent overheating, and stir the liquid in the pot just before use. Fill the mold to a depth of ¼ in. (6.35 mm) with molten sulfur material. Place the surface of the unit to be capped quickly in the liquid, and hold the specimen so that its vertical axis is at right angles to the capping surface. The thickness of the caps shall be approximately the same. Allow the unit to remain undisturbed until solidification is complete. Allow the caps to cool for a minimum of 2 h before testing the specimens.

6.3 Procedure:



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6.3.1 Test brick specimens flatwise (that is, the load shall be applied in the direction of the depth of the brick). Test structural clay tile specimens in a position such that the load is applied in the same direction as in service. Center the specimens under the spherical upper bearing within $\frac{1}{16}$ in. (1.59 mm).

6.3.2 The testing machine shall conform to the requirements of Practices E 4.

6.3.3 The upper bearing shall be a spherically seated, hardened metal block firmly attached at the center of the upper head of the machine. The center of the sphere shall lie at the center of the surface of the block in contact with the specimen. The block shall be closely held in its spherical seat, but shall be free to turn in any direction, and its perimeter shall have at least $\frac{1}{4}$ in. (6.35 mm) clearance from the head to allow for specimens whose bearing surfaces are not exactly parallel. The diameter of the bearing surface shall be at least 5 in. (127.00 mm). Use a hardened metal bearing block beneath the specimen to minimize wear of the lower platen of the machine. The bearing block surfaces intended for contact with the specimen should have a hardness not less than HRC60 (HB 620). These surfaces shall not depart from plane surfaces by more than 0.001 in. (0.03 mm). When the bearing area of the spherical bearing block is not sufficient to cover the area of the specimen, place a steel plate with surfaces machined to true planes within ± 0.001 in. (0.03 mm), and with a thickness equal to at least one third of the distance from the edge of the spherical bearing to the most distant corner between the spherical bearing block and the capped specimen.

6.3.4 *Speed of Testing*—Apply the load, up to one half of the expected maximum load, at any convenient rate, after which, adjust the controls of the machine so that the remaining load is applied at a uniform rate in not less than 1 nor more than 2 min.

6.4 Calculation and Report:

6.4.1 Calculate the compressive strength of each specimen as follows:

$$\text{Compressive strength, } C = W/A$$

where:

C = compressive strength of the specimen, lb/in.² (or kg/cm²) (or Pa · 10⁴)

W = maximum load, lbf, (or kgf) (or N), indicated by the testing machine, and

A = average of the gross areas of the upper and lower bearing surfaces of the specimen, in.² (or cm²).

NOTE 2—When compressive strength is to be based on net area (example: clay floor tile), substitute for A in the above formula the net area, in in.² (or cm²), of the fired clay in the section of minimum area perpendicular to the direction of the load.

7. Absorption

7.1 Accuracy of Weighings:

7.1.1 *Brick*—The scale or balance used shall have a capacity of not less than 2000 g, and shall be sensitive to 0.5 g.

7.1.2 *Tile*—The balance used shall be sensitive to within 0.2 % of the weight of the smallest specimen tested.

7.2 Test Specimens:

7.2.1 *Brick*—The test specimens shall consist of half brick

conforming to the requirements of 6.1.1. Five specimens shall be tested.

7.2.2 *Tile*—The specimens for the absorption test shall consist of five tile or three representative pieces from each of these five tile. If small pieces are used, take two from the shell and one from an interior web, the weight of each piece being not less than 227 g. The specimens shall have had their rough edges or loose particles ground off and, if taken from tile that have been subjected to compressive strength tests, specimens shall be free of cracks due to failure in compression.

7.3 5-h and 24-h Submersion Tests:

7.3.1 Procedure:

7.3.1.1 Dry and cool the test specimens in accordance with 4.4.1 and 4.4.2 and weigh each one.

7.3.1.2 *Saturation*—Submerge the dry, cooled specimen, without preliminary partial immersion, in clean water (soft, distilled or rain water) at 60 to 86°F (15.5 to 30°C) for the specified time. Remove the specimen, wipe off the surface water with a damp cloth and weigh the specimen. Complete weighing of each specimen within 5 min after removing the specimen from the bath.

7.3.2 Calculation and Report:

7.3.2.1 Calculate the absorption of each specimen as follows:

$$\text{Absorption, \%} = 100(W_s - W_d)/W_d$$

where:

W_d = dry weight of the specimen, and

W_s = saturated weight of the specimen after submersion in cold water.

7.3.2.2 Report the average absorption of all the specimens tested as the absorption of the lot.

7.4 1-h, 2-h, and 5-h Boiling Tests:

7.4.1 *Test Specimens*—The test specimens shall be the same five specimens used in the 5-h or 24-h cold-water submersion test where required and shall be used in the state of saturation existing at the completion of that test.

7.4.2 Procedure:

7.4.2.1 Return the specimen that has been subjected to the cold-water submersion to the bath, and subject it to the boiling test as described in 7.4.2.2.

7.4.2.2 Submerge the specimen in clean water (soft, distilled or rain water) at 60 to 86°F (15.5 to 30°C) in such a manner that water can circulate freely on all sides of the specimen. Heat the water to boiling, within 1 h, boil continuously for specified time, and then allow to cool to 60 to 86°F (15.5 to 30°C) by natural loss of heat. Remove the specimen, wipe off the surface water with a damp cloth, and weigh the specimen. Complete weighing of each specimen within 5 min after removing the specimen from the bath.

7.4.2.3 If the tank is equipped with a drain so that water at 60 to 86°F (15.5 to 30°C) can be passed through the tank continuously and at such a rate that a complete change of water takes place in not more than 2 min, make weighings at the end of 1 h.

7.4.3 Calculation and Report:

7.4.3.1 Calculate the absorption of each specimen as follows:

$$\text{Absorption, \%} = 100(W_b - W_d)/W_d$$

where:

W_d = dry weight of the specimen, and



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