Standard Test Method for Splitting Tensile Strength of Masonry Units[1]

This standard is issued under the fixed designation C 1006; 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 This test method covers the determination of the splitting tensile strength of masonry units.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E 4 Practices for Force Verification of Testing Machines

3. Significance and Use

3.1 Masonry units alone and within assemblages commonly fail in a tensile mode when loaded in compression to failure. These tensile stresses result from differences in modulus of elasticity and Poisson's ratio between the masonry unit and mortar. Additionally, the dissimilarity in behavior of the grout within cores of masonry units under load leads to tensile stresses in the units and results in a splitting failure.

3.2 This test method produces a line load along the bed surface of the masonry unit. The compressive load applied to the unit, imposed by means of bearing rods, results in a tensile stress distributed over the height of the unit for the split length of the unit. This test method can be conducted with the rod oriented either in the longitudinal direction or in the transverse direction of the bed face. The splitting tensile strength is calculated by the equation given in 7.1.

3.3 The test value provides an indicator of masonry-unit splitting tensile strength. Additionally, the presence of defects such as visible voids or impurities in masonry units may be revealed.

4. Apparatus

4.1 *Bearing Rods*—Matched, paired steel bearing rods with diameters within 1/8 to 1/12 of the specimen height, of a length greater than the length of the intended test area, and of straightness within 0.5 % of the specimen length shall be provided for each unit. Bearing rods that meet the straightness requirement can be reused.

4.2 *Supplemental Bearing Bar or Plate*—If the diameter or largest dimension of the upper bearing face or lower bearing block is less than the length of the specimen to be tested, a supplementary bearing bar or plate shall be used. The contact surfaces of the bar or plate shall be machined to within 0.05 % of planeness as measured on any line of contact of the bearing area. The bearing bar or plate shall have a width of at least 2 in. (51 mm), and a thickness not less than the distance from the edge of the spherical or rectangular bearing block to the end of the specimen. The bar or plate shall be used in such a manner that the load will be uniformly applied over the entire intended split length of the specimen.

4.3 *Testing Machine*:

4.3.1 The testing machine shall conform to the requirements of Practices E 4, and may be of any type of sufficient capacity that will provide the rate of loading prescribed in 6.3.

4.3.2 The upper, hardened metal bearing face shall be spherically seated and 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 plate in contact with the specimen. The bearing plate shall be closely held in its spherical seat but shall be free to turn in any direction; its perimeter at the ball face shall have at least 1/4 in. (6.4 mm) clearance from the head of the machine to allow for specimens whose test surfaces are not exactly parallel. The diameter of the bearing surface shall be at least 5 in. (127 mm). The bearing block surfaces that will

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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.**

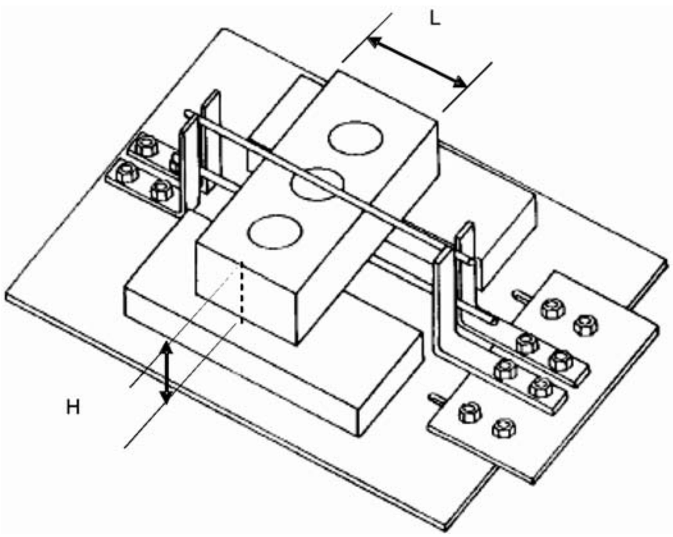

FIG. 1 Example of Alignment Jig for Maintaining Parallel Bearing Rods

contact the bearing bar or plate shall not depart from plane surfaces by more than 0.05 %.

5. Sampling

5.1 *Selection*—For the purpose of this test, full-size masonry units shall be selected at random by the purchaser or by his authorized representative. The specimens shall be representative of the whole lot of units from which they are selected and shall include units representative of the complete range of colors and sizes in the shipment.

5.2 *Number*—A minimum of five specimens shall be tested for the first 250 000 units. The minimum number of test specimens shall be increased by one unit for each 50 000 additional units or fraction thereof.

6. Procedure

6.1 *Positioning Bearing Rods*:

6.1.1 For units less than 4 in. (102 mm) high, mark the intended location of the split surface on both faces, stretcher or normally exposed faces for transverse splitting, and end faces for longitudinal splitting. Spread a gypsum capping compound (Note 1) along the bed surface between these two marks. Place the bearing rod into the fresh compound and press until contact is made with the unit. After the compound has set, place the second bearing rod parallel to the first on the opposite bed surface using an alignment device as illustrated in Fig. 1. The two rods must be within ¼ in. (6.4 mm) in 8 in. (203 mm) of being parallel.

NOTE 1—The gypsum capping compound shall be an alphagypsum hydrate hemihydrate, such as U.S. Gypsum Hydrostone.

6.1.2 For units ≥4 in. (102 mm) high, use a carpenter's square to draw a line perpendicular to the bed surface on opposite exterior faces. Spread capping compound on the upper bed surfaces between the two lines. Align the bearing rods with the lines on the faces, and press one rod into the fresh compound until in contact with the unit. After the compound has set, invert the unit and repeat this procedure on the opposite bed surface. The two companion rods must be within ¼ in. (6.4 mm) in 8 in. (203 mm) of being parallel.

6.1.3 The bearing rods shall be positioned no closer to a free edge than one half the specimen height.

6.1.4 Cure the capping compound for at least 2 h at 75 ± 15°F (24 ± 8°C) prior to testing.

NOTE 2—Alternative methods of applying the line load to the specimen have been used. Wood strips, metal bars of square cross section, and half rounds have been utilized. Such devices, meeting the dimensional requirements of 4.1, are permitted on specimens greater than 4 in. (102 mm) in height. The user of any modification should provide comparative data, testing both ways, to validate the alternative method.

6.2 *Test Alignment*—Align the rods with the centerline of the plates, and center the rods in the transverse direction. Support the specimen on compressible rods or tubes that are 1⁄16 in. (1.6 mm) smaller in diameter than the bearing rods. Remove the compressible rods when the specimen is held in vertical orientation by the testing-machine platens.

6.3 *Rate of Loading*—Apply the load without impact and load continuously at a rate less than 2000 lbf/min (8900 N/min).

NOTE 3—This requirement is met if the speed of the moving head of the testing machine immediately prior to application of load is not more than 0.5 in./min (12.7 mm/min).

6.4 *Measurement*—Determine the height of the specimen to the nearest 0.1 in. (2.5 mm) by averaging three heights measured near the ends and the middle and on a plane perpendicular to the bed surface. Determine the split length of the specimen to the nearest 0.1 in. (2.5 mm) by averaging at least two measurements taken on the plane of the bearing rods. The split length is the actual net length of the failure plane of the bearing rods and is equal to the gross length of the unit minus the length of any voids along this plane.

7. Calculations

7.1 Calculate the splitting tensile strength of the specimens as follows:

$$f_t = 2P/\pi LH \tag{1}$$

where:

f_t = splitting tensile strength, psi (kPa),
P = maximum applied load indicated by the testing machine, lb (kN),
L = split length, in. (mm), gross length minus the length of any voids along the failure plane of the bearing rods, and
H = distance between rods, in. (mm).

8. Report

8.1 The report shall include the following for each masonry unit.

8.1.1 Type and dimensions of specimen,

8.1.2 Identification number,

8.1.3 Split length and height of split area of specimen in inches (mm),

8.1.4 Maximum load in pound force (kilonewtons),

8.1.5 Splitting tensile strength calculated to the nearest 5 psi (50 kPa), 8.1.6 Visible voids and impurities in specimen, and

8.1.7 Description of fracture.

8.2 Report and average splitting tensile strength of the units tested.

9. Precision and Bias

9.1 The laboratory coefficient of variation of test results available is high because of the variability of the material property tested. Coefficients of variation for groups of five specimens ranged from 3 to 40 %, averaging 20 %.

9.1.1 It is expected that the multilaboratory coefficients of variation will be higher than the single operator or single laboratory coefficient of variation.

9.1.2 Tests conducted with rods oriented longitudinally on bed faces normally have higher coefficients of variation than tests conducted with rods oriented transversely.

10. Keywords

10.1 brick; concrete masonry units; masonry; splitting strength; tensile strength

SUMMARY OF CHANGES

Committee C15 has identified the location of selected changes to this standard since the last issue (C 1006 – 84 (2001)) that may impact the use of this standard. (Approved Oct. 1, 2007.)

(*1*) Subsections 3.2 and 9.1.2 have been modified to clarify the meaning of testing in the longitudinal and transverse directions.

(*2*) Changes have been made throughout the standard to adjust the metric equivalences so that they have the same number of significant figures as the inch-pound units.

(*3*) The curing temperature range in 6.1.4 has been changed to make it consistent with other laboratory test methods.

(*4*) Note 1 has been modified to remove a reference to a material source that is not commonly used.

(*5*) Subsection 6.4 and the definition for L in 7.1 have been modified to clarify how to determine the split length.

(*6*) Eq 1 has been modified to change T to the more commonly used f_t.

(*7*) The definition for H in 7.1 has been clarified.

(*8*) Fig. 1 has been clarified by showing the orientation of L and H.