Designation: ~~C1505 – 01 (Reapproved 2007)~~ C1505 – 15

Standard Test Method for Determination of Breaking Strength ~~of Ceramic Tiles~~ and Modulus of Rupture of Ceramic Tiles and Glass Tiles by Three-Point Loading[1]

This standard is issued under the fixed designation C1505; 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 breaking strength ~~of ceramic tiles~~ and modulus of rupture of ceramic tiles and glass tiles by three-point loading.

1.2 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound 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]

C242 Terminology of Ceramic Whitewares and Related Products

3. Terminology

3.1 For the definitions of terms used on this test method, refer to Terminology C242.

4. Summary of Test Method

4.1 This test method consists of determining the breaking strength ~~of ceramic tiles~~ and modulus of rupture of ceramic tiles and glass tiles using a three-point loading method. The tiles are supported on two cylindrical support rods positioned to provide an appropriate span. A load is applied at a uniform rate using a third central cylindrical rod positioned at the midpoint between the support rods. The breaking strength ~~is calculated by multiplying~~ and modulus of rupture are calculated using the load at which ~~the tile breaks by the ratio of the span between support rods divided by the width of the specimen.~~tile failure is observed, the dimensions of the tile specimen, and the span between the support rods. Optionally, the deflection at which the tile failure is observed may be reported.

5. Significance and Use

5.1 This test method is intended for determining the breaking strength ~~of ceramic tiles~~ and modulus of rupture of ceramic tiles and glass tiles for compliance with requirements that may appear in specifications.

6. Apparatus

6.1 *Testing Machine,* capable of loading at a uniform rate sufficient to increase the stress in the specimen at a rate of 1 ± 0.2 N/mm^2 (145 ± 29 psi) per second. At minimum, the testing machine shall record loading data at the point at which specimen failure is observed. Optionally, the testing machine may record deflection data. The rod support table of the testing machine shall be ~~indexed~~adjustable such that the cylindrical support rods ~~are positioned at 4 mm increments.~~ can accommodate a variety of specimen sizes.

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[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.06 on Ceramic Tile.

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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.

6.2 *Cylindrical Support Rods,* 2, of length, *w*, with a steel core of diameter, *d*, and a rubber bearing surface of 55 ± 3 Shore A durometer hardness and thickness, *t* (see Table 1). One rod shall be permitted to pivot slightly relative to its length and the other shall be permitted to rotate slightly relative to its axis (see Fig. 1).

6.3 *Central Cylindrical Rod,* of length, *w*, with a steel core of diameter, *d*, and a rubber bearing surface of 55 ± 3 Shore A durometer hardness and thickness, *t*. The rod shall be permitted to pivot slightly relative to its axis.

7. Sampling

7.1 The test sample shall consist of ten whole tiles, selected at random from the lot to be tested. Tiles too large to be tested whole may be cut; however, the cut specimens shall be square and as large as possible, though not larger than the rod length. The centerpoint of the cut specimen shall coincide with the original centerpoint of the whole tile.

8. Procedure

8.1 Position the cylindrical support rods (6.2) on the rod support plate (6.2) with an appropriate span, *L*, ~~to the nearest 4 mm~~ so that the specimens will overhang each support rod by length, *l* (see Table 1). Place each specimen face ~~up~~ up, unless otherwise specified, on the support rods. In the case of reversible tile, such as unglazed ceramic mosaic tile, it is immaterial which side of the specimen is up. If applicable, position each specimen so that the longer side or the directional back-pattern is at right angles to the supports. In the case were both conditions exist, the orientation of the longer side shall take precedence.

8.2 Position the central cylindrical rod (6.3) on the face of the specimen at the midpoint between the support rods. Load the specimen with the central rod at a uniform rate sufficient to increase the stress in the specimen at a rate of 1 ± 0.2 N/mm^2 (145 ± 29 psi) per second. The load rate in N/s can be determined by the following equation:

$$r = 2bh^2/3L \quad (1)$$

where:

r = load rate, in N/s,
b = the width of the specimen, in mm,
h = the minimum thickness of the specimen, in mm, and
L = the span between the cylindrical support rods, in mm.

Record the load at which the specimen breaks into two or more pieces.

8.3 Record the load at which specimen failure is observed. Failure is defined as the specimen breaking into two or more pieces or when a reduction in load of 5% or greater is observed for the first time.

8.4 *Optional*—Record the deflection, in mm, at which specimen failure is observed.

8.5 Repeat the procedure until all specimens in the sample have been ~~broken.~~tested.

9. Calculation

9.1 Calculate the breaking strength of each specimen using the following equation:

$$B = PL/b \quad (2)$$

where:

B = breaking strength, in N,
P = ~~load at which the specimen broke, in N,~~

TABLE 1 Length of Rod, Diameter of Core, Thickness of Rubber, and Overhang (See Fig. 2)

Minimum Dimension (mm)	Length of Rod, *w* (mm)	Diameter of Core, *d* (mm)	Thickness of Rubber, *t* (mm)	Length of Overhang, *l* (mm)
~~≥95~~	~~560~~	~~20~~	~~5 ± 1~~	~~≤8 but >4~~
~~<95 but ≥52~~	~~130~~	~~10~~	~~2.5 ± 0.5~~	~~≤4 but >0~~
~~<52 but ≥18~~	~~60~~	~~5~~	~~1 ± 0.2~~	~~≤4 but >0~~

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≥95	560	20	5 ± 1	10 ± 5
<95 but ≥52	130	10	2.5 ± 0.5	5 ± 2
<52 but ≥18	60	5	1 ± 0.2	2 ± 1