Standard Test Method for
Determination of Breaking Strength of Ceramic Tiles by Three-Point Loading[1]

This standard is issued under the fixed designation C 1505; 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 by three-point loading.

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:* [2]

C 242 Terminology of Ceramic Whitewares and Related Products

3. Terminology

3.1 For the definitions of terms used on this test method, refer to Terminology C 242.

4. Summary of Test Method

4.1 This test method consists of determining the breaking strength of ceramic 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 the load at which the tile breaks by the ratio of the span between support rods divided by the width of the specimen.

5. Significance and Use

5.1 This test method is intended for determining the breaking strength of ceramic 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. The rod support table of the testing machine shall be indexed such that the cylindrical support rods are positioned at 4 mm increments.

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 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:

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

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

where:
r = load rate, in N/s,
b = the width of the specimen, in mm,
h = the 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 Repeat the procedure until all specimens in the sample have been broken.

9. Calculation

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

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

where:
B = breaking strength, in N,
P = load at which the specimen broke, in N,
L = the span between the cylindrical support rods, in mm, and
b = the width of the specimen, in mm.

9.2 Calculate the average breaking strength of the acceptable results. Only the results of specimens that break at the midpoint between the support rods, plus or minus the radius of the central cylindrical rod are acceptable. A minimum of five acceptable results is necessary to calculate the average breaking strength. If there are fewer than five acceptable results, a second sample of twice the minimum number of specimens shall be tested; a minimum of ten acceptable results will be necessary to calculate the average breaking strength.

10. Report

10.1 The test report shall include the following information:
10.1.1 A description of the tiles;
10.1.2 The number of specimens;
10.1.3 The values of w, d, t, l, L, b, and h;
10.1.4 The load, P, at which each specimen broke;
10.1.5 The breaking strength of each specimen;
10.1.6 The average breaking strength of the acceptable results.

11. Precision and Bias

11.1 The precision of the procedure in this Test Method for determining breaking strength of ceramic tile by three-point loading is being determined and will be available on or before November 2002. It is not feasible to specify the precision of the procedure at this time because the interlaboratory study has not been completed.

11.2 No information can be presented on the bias of the procedure in this test method for determining breaking strength of ceramic tile by three-point loading because the interlaboratory study has not been completed.

12. Keywords
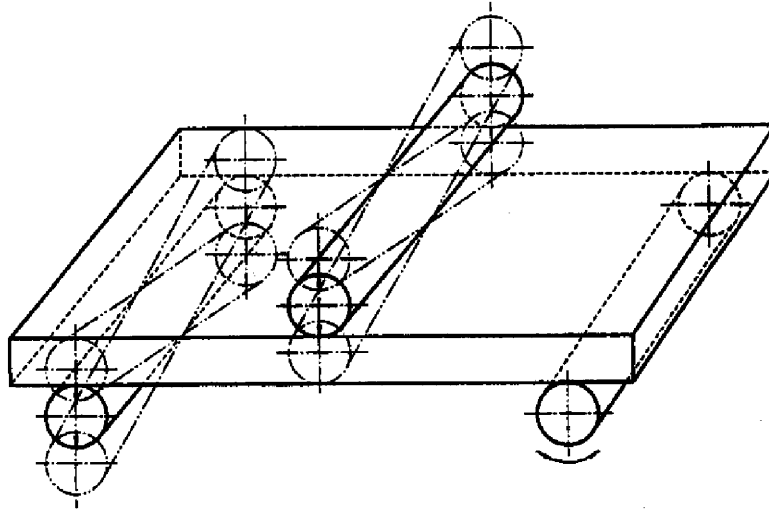
12.1 breaking strength; ceramic tile
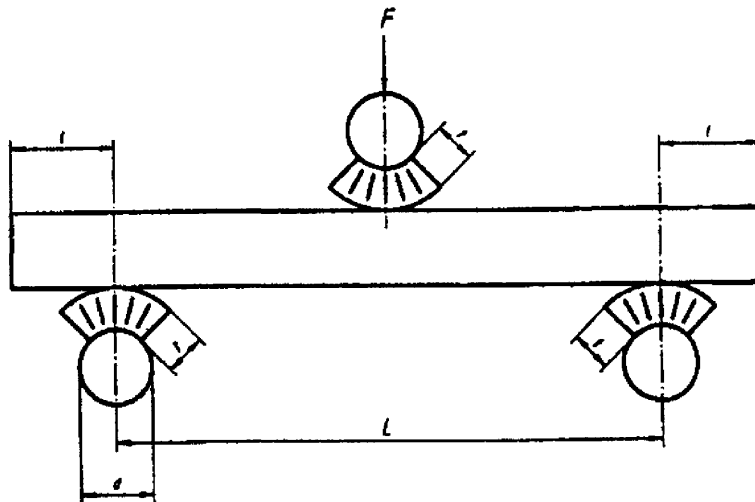
FIG. 1 Rotation and Pivot of Cylindrical Rods

FIG. 2 Position of Cylindrical Rods

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