



Designation: C485 – 16

## Standard Test Method for Measuring Warpage of Ceramic Tile<sup>1</sup>

This standard is issued under the fixed designation C485; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers procedures for measuring the corner, diagonal, and edge warpages of the following categories of ceramic tile:

1.1.1 *Square Tile*, 2 by 2 in. (51 by 51 mm) or larger, that are nominally flat, of uniform overall thickness, and have a smooth face of one of the types: unglazed, bright glazed, matte glazed, or finely crystalline glazed.

1.1.2 *Oblong Tile*, no facial dimension smaller than 2 in. (51 mm), that are flat, of uniform overall thickness, and have a smooth face of one of the types: unglazed, bright glazed, matte glazed, or finely crystalline glazed.

1.1.3 *Square and Oblong Tile*, no facial dimension smaller than 2 in. (51 mm), that are flat, but have an irregular face such as embossed, sloped, bumpy, wavy, coarsely crystalline, or wire-cut textured.

1.1.4 *Nonrectilinear Tile*, larger than 4 in.<sup>2</sup> (26 cm<sup>2</sup>), that are flat and of uniform body thickness with smooth or irregular face, such as hexagonal, diamond, Spanish type, and so forth.

1.1.5 *Trim Tile* meeting one of the descriptions in 1.1.1 – 1.1.4 except that only a part of the tile surface is flat. (Surface trim tile should be treated as flat tile whenever possible.)

1.1.6 *Square or Oblong Tile* with facial area less than 4 in.<sup>2</sup> (26 cm<sup>2</sup>) and at least two straight sides equal to or greater than 1.0 in. (25 mm) long. (Modular 1- by 1-in. tile are not in the scope of this test method.)

1.2 This test method is not applicable to tile having embossed surfaces that are not flat, or that have a combination of variable body thickness and an irregular face.

1.3 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.

1.4 *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*:<sup>2</sup>

C242 *Terminology of Ceramic Whitewares and Related Products*

2.2 *ASTM Adjuncts*:

Warpage Gage for Ceramic Tile<sup>3</sup>

### 3. Terminology

3.1 *Definitions*:

3.1.1 *contact warpage device, n*—consisting of a fixture that has reference pins, contact gauges, and zero blank plates. The device can be specific to a tile size or adjustable. Typically the tile rests on the pins and the zero plane is fixed from these contact points.

3.1.2 *non-contact warpage device, n*—a device that uses some form of non-contact method to take measurements. An example would be laser measurement. These devices can use a fixed reference plane (zero with flat blanks) or calculate a theoretical reference plane.

3.1.3 *reference plane, n*—the zero plane from which tile planar deviations are measured.

3.1.4 *tile, n*—see Definitions C242.

3.1.5 *warpage, n*—curvature of a flat tile measured as deviation of the tile surface from a true plane along the edges, at the corners, or the diagonals. The deviation is measured at the mid-length of an edge or diagonal, or at a corner, expressed as a percentage of the length of the edge, diagonal, or corner, and called convex or concave with respect to the face of the tile.

### 4. Summary of Test Method

4.1 This method calculates the deviation of a ceramic tile from a flat plane. Measurements are made along the edges,

<sup>1</sup> This 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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<sup>2</sup> 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.

<sup>3</sup> Three drawings showing construction details are available from ASTM Headquarters. Order ADJC0485.

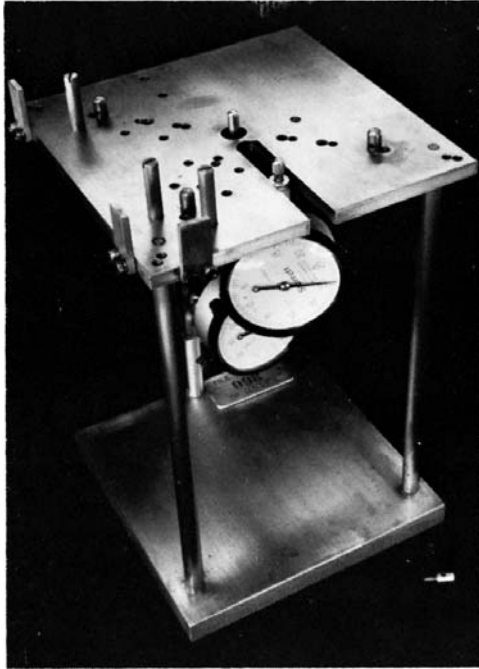


FIG. 1 Contact Apparatus for Square Tile, Set Up for Measurement of 4 1/4- by 4 1/4-in. (108- by 108-mm) Tile

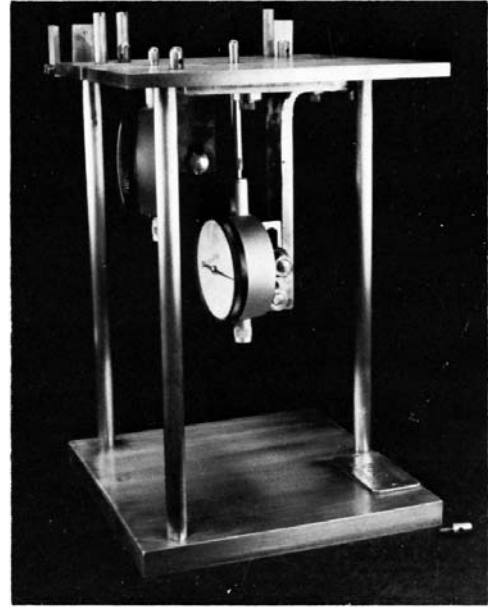


FIG. 2 Apparatus as Shown in Fig. 1, Showing Arrangement of Stem Extender

diagonals, and corners of a tile. The deviation is expressed as convex (positive) or concave (negative) warpage in relation to the tile face.

## 5. Significance and Use

5.1 This test method provides a means for determining whether or not a lot of ceramic tile meets the warpage requirements that may appear in specifications to assure satisfactory tile installations. In accordance with this test method, warpage is calculated as a percentage of the length of the edge or diagonal being tested. It is realized that the percentage values based on the overall edge length, or on the overall diagonal length of a tile will be slightly lower than those based on the distance between reference points. However, the ratio of the overall lengths to the distance between reference points will be practically constant for any particular size of tile and, therefore, the percentage values will be comparable and equally indicative of warpage.

## 6. Apparatus

6.1 *Edge and Diagonal Apparatus*—The size and arrangement of the apparatus for measuring the warpages vary, depending on the size and shape of the tile to be measured. The apparatus may be of contact or non-contact in type, capable of differentiating between the tile and a true flat plane. It must be able to measure the displacement (to 0.1 mm) from a true plane at the center of the tile edges and at the corners. This displacement is relative to a plane fixed at reference points 10 mm from each tile corner.

6.2 *Corner Warpage Apparatus*—This device may be contact or non-contact in nature capable of detecting deflection from a plane as indicated below. It must be able to measure the

displacement 10 mm from corner and fixed 50 mm outside of a plane (to 0.1 mm) as illustrated below.

## 7. Test Specimens

7.1 At least ten tile specimens shall be selected at random from the lot to be tested. Brush the specimens to remove all adhering particles of clay or sand.

## 8. Procedure

### 8.1 Edge Warpage:

8.1.1 Zero out the device to the reference plane (if needed).

8.1.2 Align the device with the face of the tile such that the plane measured conforms to Section 6.

8.1.3 Measure the displacement of the edge at the center along the gauge length, with positive values being convex and negative values being concave with respect to the face of the tile.

8.1.4 Record the results.

8.1.5 Rotate the tile or device 90 degrees to measure the next side. Re-zeroing may be necessary if the tile is not square.

8.1.6 Repeat steps 8.1.2 – 8.1.5 until all four sides are measured.

### 8.2 Diagonal Warpage:

8.2.1 Zero out the device to the reference plane (if needed).

8.2.2 Align the device with the face of the tile such that the plane measured conforms to Section 6.

8.2.3 Measure the displacement at the center along the diagonal gauge length (center of the tile), with positive values being convex and negative values being concave with respect to the face of the tile.

8.2.4 Record the results.