



Designation: **C373 – 88 (Reapproved 2006) C373 – 14**

## Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products~~Products~~, Ceramic Tiles, and Glass Tiles<sup>1</sup>

This standard is issued under the fixed designation C373; 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 determining water absorption, bulk density, apparent porosity, and apparent specific gravity of fired unglazed whiteware ~~products~~products, glazed or unglazed ceramic tiles, and glass tiles.

1.2 The values stated in metric units are normative. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not normative.

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. Significance and Use

2.1 Measurement of density, porosity, and specific gravity is a tool for determining the degree of maturation of a ceramic body, or for determining structural properties that may be required for a given application.

### 3. Apparatus and Materials

3.1 *Balance*, of adequate capacity, suitable to weigh accurately to 0.01 g (0.00002 lb).

3.2 *Oven*, capable of maintaining a temperature of  $150 \pm 5^\circ\text{C}$  ( $302 \pm 9^\circ\text{F}$ ).

3.3 *Wire Loop, Halter, or Basket*, ~~Basket~~, capable of supporting specimens under water for making suspended mass measurements.

3.4 ~~Container~~*Suspended Mass Container (If Determination of Suspended Mass is Desired)*—A glass beaker or similar container of such size and shape that the sample, when suspended from the balance by the wire loop, specified in 3.3, is completely immersed in water with the sample and the wire loop ~~being~~ completely free of contact with any part of the container.

3.5 ~~Pan~~*Stainless Steel Boiling Container*, suitable for boiling water and with sufficient capacity to hold the test specimens and quantity of water specified in 5.2 ~~which the specimens may be boiled.~~ The container shall be equipped with a loose removable cover which does not allow pressure to build.

3.6 ~~Distilled~~*Deionized (DI) Water*.

3.7 *Leather Chamois*.

3.8 *Heat Source*, such as a hot plate, burner, or equivalent to heat the water to boiling.

3.9 *Desiccator*, a sealed chamber containing desiccants which is of sufficient size and capacity to allow specimens to cool while preventing the specimens from absorbing moisture from ambient air.

### 4. Test Specimens

4.1 ~~At least five representative test specimens shall be selected. The specimens shall be unglazed and shall have as much of the surface freshly fractured as is practical. Sharp edges or corners shall be removed. The specimens shall contain no cracks. The individual test specimens shall weigh at least 50 g.~~*Ceramic Whitewares*

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.03 on Methods for Whitewares and Environmental Concerns.

Current edition approved Feb. 15, 2006 March 1, 2014. Published February 2006 March 2014. Originally approved in 1955. Last previous edition approved in 1999 2006 as C373 – 88 (1999) (2006). DOI: 10.1520/C0373-88R06-10.1520/C0373-14.

4.1.1 At least five representative test specimens shall be selected that have not been previously tested. The specimens shall be unglazed and shall have as much of the surface freshly fractured as is practical. Sharp edges or corners shall be removed. The specimens shall contain no cracks. The individual test specimens shall weigh at least 50 g.

#### 4.2 *Ceramic Tiles and Glass Tiles*

4.2.1 The specimens shall contain no visible damage or cracks prior to testing. At least five representative test specimens shall be selected that have not been previously tested. Cutting of specimens, as described in the following sections, shall consist of scoring and snapping, or sawing when impossible to score and snap with conventional tile scoring equipment (as can be the case with some glass tiles and highly textured and structured porcelain tiles).

4.2.2 For tiles less than or equal to 205 × 205 mm (8 × 8 in.), specimens shall be cut in half, within 10 mm (0.4 in.). Specimens shall be cut perpendicular to the longest side if the specimen has unequal sides. Select one half at random from each specimen for testing.

4.2.3 For tiles greater than 205 × 205 mm (8 × 8 in.) and less than or equal to 410 × 410 mm (16 × 16 in.), each specimen shall be cut into four equal quadrants, within 10 mm (0.4 in.). Select one quadrant at random from each specimen for testing.

4.2.4 For tiles greater than 410 × 410 mm (16 × 16 in.), a 205 × 205 mm (8 × 8 in.) portion, within 10 mm (0.4 in.), shall be cut from one corner of each specimen for testing.

4.2.5 For non-square tiles which have a side less than or equal to 205 mm (8 in.) and a side greater than 205 mm (8 in.), each specimen shall be cut once perpendicular to the longest side, such that a 205 mm (8 in.) portion, within 10 mm (0.4 in.), from the end remains.

4.2.6 If a tile does not weigh at least 50 g (0.11 lb) prior to cutting, then multiple whole pieces may be used to equal one test specimen with a mass of at least 50 g (0.11 lb).

## 5. Procedure

5.1 Dry the test specimens to constant mass (Note 1) by heating in an oven at 150°C (302°F), 150 ± 5°C (302 ± 9°F) for a minimum of 24 h (or such other time as has been established for the oven in use and the mass of the tiles being dried), followed by cooling in a desiccator. Determine the dry mass,  $D$ , to the nearest 0.01 g-g (0.00002 lb) (see Note 1).

NOTE 1—Specimens being tested directly following their manufacture may be considered fully dried so long as they have not been subjected to any process that wets the specimen post firing (such as can occur in cutting and polishing operations) and are placed in a desiccator sufficiently quickly (usually within no more than 30 minutes of exiting the kiln) that no moisture has been absorbed from ambient air.

NOTE 2—The drying of the specimens to constant mass and the determination of their masses may be done either before or after the specimens have been impregnated with water. Usually the dry mass is determined before impregnation. However, if the specimens are friable or evidence indicates that particles have broken loose during the impregnation, the specimens shall be dried and weighed after the suspended mass and the saturated mass have been determined, in accordance with 5.35.4 and 5.45.5. In this case, the second dry mass shall be used in all appropriate calculations.

5.2 Addition of Specimens to DI Water ~~Place the specimens in a pan of distilled water and boil for 5 h, taking care that the specimens are covered with water at all times. Use setter pins or some similar device to separate the specimens from the bottom and sides of the pan and from each other. After the 5-h boil, allow the specimens to soak for an additional 24 h.~~

5.2.1 For ceramic whitewares, glass tiles, and pressed ceramic tiles: bring DI water to a boil in a stainless steel boiling container. Place the specimens in the boiling DI water, and use setter pins, a rustproof rack, or equivalent to separate the specimens from the bottom and sides of the stainless steel boiling container and from each other. The DI water shall be unused and of sufficient quantity that the test specimens are fully submerged and the mass ratio of water to test specimens is at least 3:1.

5.2.2 For extruded ceramic tiles: place the specimens in a stainless steel boiling container of DI water at room temperature, and use setter pins, a rustproof rack, or equivalent to separate the specimens from the bottom and sides of the stainless steel boiling container and from each other. The DI water shall be unused and of sufficient quantity such that the test specimens are fully submerged and the mass ratio of water to test specimens is at least 3:1. Bring the DI water with submerged specimens to a boil in one hour or less.

5.3 Boil the specimens for 5 h ± 5 min. Place a loose cover over the container to minimize water loss through evaporation. Test specimens shall be completely immersed in the boiling DI water throughout the duration of the 5 h boil. Add DI water as needed to ensure the specimens are completely immersed at all times. Ensure that the boil is maintained throughout the test and that the addition of water does not hinder the boil. After the 5-h boil, allow the specimens to continue to soak in the same DI water in which they were boiled for an additional 24 h ± 30 min., ensuring that the specimens remain completely immersed.

5.4 After ~~impregnation~~ the 24-h soak of the test specimens, determine to the nearest 0.01 g (0.00002 lb) the mass,  $S$ , of each specimen while suspended in water. Perform the weighing by placing the specimen in a wire loop, halter, or basket that is suspended from one arm of the balance. Before actually weighing, counterbalance the scale with the loop, halter, or basket in place and immerse in water to the same depth as is used when the specimens are in place. If it is desired to determine only the percentage of water absorption, omit the suspended mass operation.

5.5 After the determination of the suspended mass, or after ~~impregnation~~ the 24-h soak, if the suspended mass is not determined, blot each specimen lightly with a ~~moistened, lint-free linen or cotton cloth damp leather chamois~~ to remove all ~~excess~~ excess visible water from the surface, and determine the saturated mass,  $M$ , to the nearest 0.01 g. ~~Perform the blotting operation~~