



## Standard Test Method for Determination of Resistance to Staining<sup>1</sup>

This standard is issued under the fixed designation C 1378; 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 approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method is intended to determine the resistance to staining of ceramic tile surfaces.

1.2 The resistance to staining is determined by maintaining test solutions in contact with ceramic tile surfaces for a specified period of time. After exposure, the surface is cleaned in a defined manner, and the test specimens are inspected visually for change.

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. Staining Agents

2.1 *Contrasting Grout*, unsanded tile grout, applied as a neat paste.

2.2 *Carbon Lamp Black*.<sup>2</sup>

2.3 *Waterproof Ink Black*.<sup>3</sup>

2.4 *Washable Ink*.<sup>4</sup>

2.5 *Potassium Permanganate Solution, 1 %*, prepared from 99 %  $\text{KMnO}_4$  crystals, dissolve 1g of reagent into 100 mL of distilled water.

2.6 *Methylene Blue Solution, 1 %*.<sup>5</sup>

2.7 This test method may be used for exposing tile to any staining agent deemed appropriate for the expected service conditions and may specify any reasonable combination of time and temperature for the exposure period. Exposure substances, time, and temperatures should be selected so as to either simulate service conditions, or accelerate staining that is possible under expected service conditions, or bear some other meaningful relation to expected service conditions.

### 3. Apparatus

3.1 *Test Tubes*, plain end glass test tubes with a diameter of 20 mm and a length of 150 mm.

3.2 *Pipets*, glass pipet with a volume of at least 50 mL with gradations in 1-mL increments.

3.3 *Oven*, capable of maintaining a constant temperature of  $110 \pm 5^\circ\text{C}$ .

3.4 *Cloths*, a supply of lintless, absorbent clothes or paper towels.

3.5 *Distilled or Deionized Water*, for preparation of the solutions.

3.6 *Light Source*, standard light source that supplies a 300 lux of illumination.

3.7 *Cleaning Agents*.

3.7.1 *Hot water*.

3.7.2 *Weak cleaning agent*, a commercial agent, not containing abrasive, with a pH of 6.5 to 7.5.

3.7.3 *Strong cleaning agent*, a commercial cleaning agent containing abrasive, with a pH of 9 to 10.

3.7.4 *Suitable solvents*:

3 % (v/v) HCl solution, prepared from 38 % hydrochloric acid by adding 79 mL of the reagent hydrochloride acid solution to 951 mL of distilled water.

20 % KOH solution (200 g/L), prepared by dissolving 200 g of 90 % potassium hydroxide into 1 L of distilled water. Acetone (technical grade).

### 4. Samples

4.1 *Number of Test Specimens*—One defect-free test specimen, which is representative of the entire surface, for each test solution is to be used. Test specimens shall be representative of the sample, and where tiles have different colors of decorative effects, care should be taken to include all distinctive parts. More test specimens may be necessary to incorporate all surface features.

4.2 *Size of Specimens*—The original tile for testing should be cut to 50- by 50-mm squares for testing with each cut piece labeled according to the testing solution to be applied.

4.3 The sample surfaces should be thoroughly cleaned with a suitable solvent, such as acetone and completely dried before testing.

<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 C21.06 on Ceramic Tile.

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<sup>2</sup> Technical grade is available from Fischer Scientific, 2000 Park Lane, Pittsburgh, PA 15275.

<sup>3</sup> Use permanent black ink, Quilt by Parker, or an equivalent.

<sup>4</sup> Use washable blue ink, Quilt by Parker, or an equivalent.

<sup>5</sup> Aqueous solution is available from Fischer Scientific, 2000 Park Lane, Pittsburgh, PA 15275.

4.4 The test specimens can be glazed or unglazed tile. If the tiles are glazed, then the staining agent should be applied to the glazed surface.

## 5. Procedure for Staining Agent Application

### 5.1 Application of the Staining Agent:

5.1.1 Dry the test specimens thoroughly at  $110 \pm 5^\circ\text{C}$  before testing and then cool the tile to room temperature.

5.1.2 The labeled test specimens are laid out on a table in a well-ventilated area.

**NOTE 1—Precaution:** This test method involves the use of chemical substances. Proper precautions for the handling of these chemicals should be taken, such as protective clothing and fume hoods.

5.1.3 Transfer 5mL of the liquid staining agent described in 2.3-2.6 to a test tube.

5.1.4 Place the surface to be tested of the tile face down on the open end of the test tube.

5.1.5 While firmly holding the test tube and tile assembly together, invert the assembly so that the back of the tile is facing the table and the closed end of the test tube is facing up.

5.1.6 Carefully place the assembly on the table and leave undisturbed for 24 h.

5.1.7 For the dry staining agents described in 2.1 and 2.2, apply a generous amount of the staining agent with a cloth in the center of the test specimen, being sure to leave some unexposed area for comparison. The grout described in 2.1 should be mixed with enough distilled water to make a neat paste before application. For light-colored tile, black grout should be used, and for dark tile, white grout should be used.

### 5.2 Removal of the Test Solutions:

5.2.1 After 24 h of contact between the test specimens and the liquid staining agents has expired, again invert the assembly so that the test solution is contained in the test tube, and remove the test tube from the specimen and dispose of the staining agent properly.

5.2.2 For the solid staining agents, proceed directly to the cleaning procedures.

5.3 *Cleaning Procedures*—The following cleaning procedures (A, B, C, and D) will be tried in succession until one of the procedures is successful at removing the stain. If the first procedure is successful, it is not necessary to try the remaining

three procedures. After each cleaning procedure, the samples are dried thoroughly at  $110 \pm 5^\circ\text{C}$  and cooled to room temperature.

5.3.1 *Procedure A*—Flow of running hot water for 5 min; the surface then is wiped with a damp cloth.

5.3.2 *Procedure B*—Hand cleaning with the weak cleaning agent (3.7.2); a natural, unabraded sponge or a cloth can be used. The surface then is rinsed with running water and finally wiped with a damp cloth.

5.3.3 *Procedure C*—Mechanical cleaning such as a rotating brush with hard bristles having a 8-cm diameter and automatic cleaning agent feed using the strong cleaning agent (3.7.3). The cleaning action is applied for approximately 2 min, then the surface is rinsed with running water and finally wiped with a damp cloth.

5.3.4 *Procedure D*—Immersion, for 24 h, of the test specimens in the suitable solvent listed in 3.7.4 that is capable of removing the stain.

5.4 Dry the specimens thoroughly at  $110 \pm 5^\circ\text{C}$  and cool to room temperature before evaluation.

## 6. Evaluation of Results

6.1 *Visual Evaluation*—Examine the surface at a standard distance of 25 cm and a standard illumination of approximately 300 lux. Rotate the sample to examine it from multiple angles. Examine for differences in appearance between the treated and untreated area. If the sample is stained visibly by the staining agent, then the results of that testing solution will be recorded as “affected.”

## 7. Report

7.1 Make out a report with each of the staining agents used (see Fig. 1);

7.2 Identify the tile being tested by type, size, and state whether glazed or unglazed;

7.3 State the test conditions, that is, type of staining agents used, temperatures maintained during the test, and length of exposure; and

7.4 Report the results of the visual inspection for each tile by the simple statements “affected” or “not affected.”

## 8. Precision and Bias

8.1 *Qualitative Procedure*—This test method is a qualitative or pass/fail test; hence, precision and bias are not applicable.

<b>Sample Name:</b>		
<b>Sample Size:</b>		
<b>Sample Color:</b>		
<b>Sample Surface Condition:</b>		
<b>Staining Agent</b>	<b>Visual Test (Affected/Not Affected)</b>	<b>Number of Samples</b>
Contrasting Grout		
Carbon Lamp Black		
Waterproof Ink Black		
Washable Ink		
Potassium Permanganate Solution, 1%		
Methylene Blue Solution, 1%		

**FIG. 1 Sample Test Certificate**

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