Designation: ~~C650 – 04 (Reapproved 2019)~~ C650 – 20

Standard Test Method for ~~Resistance~~Determination of ~~Ceramic Tile~~ Resistance to Chemical Substances[1]

This standard is issued under the fixed designation C650; 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 a procedure for determining whether, and to what degree, ceramic tiles and glass tiles are affected by prolonged exposure to chemical substances that are commonly used in the household or for cleaning purposes as well as other more severe conditions.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.2.1 The units used for concentration in this standard are ~~v/v~~v/v, which refers to the volume of reagent/1 L of solution, and ~~g/L~~g/L, which refers to the weight of reagent, in g, to be dissolved in 1 L of water.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Summary of Test Method

2.1 This test method calls for one or more tests, each consisting of exposing flat pieces of ~~ceramic~~ tile to the action of a specific chemical substance for a definite period of ~~time at a prescribed temperature.~~ time. After exposure, the surfaces of the tile are rinsed with water and inspected for effect.

3. Significance and Use

3.1 This test method is intended for testing ~~ceramic tile~~ tiles that are to be used for food counters, lavatories, and similar residential, medical, and commercial installations, where they may come in contact with food, chemical, and waste substances and for tile in areas where they may be exposed to contact with strong cleaning agents.

~~3.2 The specification of 10 % hydrochloric acid solution and 10 % potassium hydroxide solution as normal testing fluids, and the length of exposure time and temperature are based on experimental laboratory work and interlaboratory tests, where it was indicated that resistance to these two substances probably assures resistance also to any other acidic or alkaline substance coming in contact with tile, except hydrofluoric acid.~~

~~3.3 The validity of using color difference as means of determining the degree to which tile surfaces are affected by acids and alkalies has been established by interlaboratory test and was found to be more reliable than the determination of loss of gloss, particularly for unglazed tile and mat or semimat glazed surfaces. Lack of coordination between instrumental value and visual effect was noted only in the case of minute surface changes, detectable only by oblique viewing.~~

4. Apparatus

4.1 ~~*Test*~~ *Glass Test Tubes or PVC Tubes,* plain-end flint glass test tubes or PVC tubes with a diameter of approximately 20 mm and a length ~~of 150 mm.~~sufficient to contain the required amount of test solution.

~~4.2 *Pipets,* glass with a volume of at least 50 mL with gradations in 1-mL increments.~~

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

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4.2 *Oven,* capable of maintaining a constant temperature of ~~110 ± 5 °C.~~at least 110 °C.

4.3 *Pencil,* HB hardness grade.

4.4 *Cloths,* a supply of lintless, absorbent cloths or paper towels.

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

4.6 *Light Source,* standard, that supplies a ~~300 lux~~ minimum of 300 lux illumination.

5. Reagents

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[2] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 The required dilutions for the preparation of each test solution is found in Table 1 of this test method.

5.2.1 *Common Household and Cleaning Chemicals:*

5.2.1.1 Acetic acid, 3 % (v/v).

5.2.1.2 Acetic acid, 10 % (v/v).

5.2.1.3 Ammonium chloride, 100 g/L.

TABLE 1 Preparation of Test Solutions

NOTE 1—When mixing solutions using solid reagents, the reagent should be dissolved in a small amount of water first, and then water should be added to the solution such that the final volume of the solution is 1000 mL. For example, when mixing the citric acid solution, 30 g/L, dissolve 30.2 g of 99.5 % citric acid in 250 mL of water. After the reagent is dissolved, continue adding water until the solution has a final volume of 1000 mL.

Test Solution	Reagent Source	Amount of Reagent Required for Test Solution (See Note 1)	Distilled Water Required for Test Solution
	Common Household and Cleaning Chemicals		
~~Acetic acid, 3 % (v/v)~~	~~99.7 % glacial acetic acid~~	~~30 mL~~	~~970 mL~~
acetic acid, 3 % (v/v)	99.7 % glacial acetic acid	30.1 mL	969.9 mL
~~Acetic acid, 10 % (v/v)~~	~~99.7 % glacial acetic acid~~	~~100 mL~~	~~900 mL~~
acetic acid, 10 % (v/v)	99.7 % glacial acetic acid	100.3 mL	899.7 mL
~~Ammonium chloride, 100 g/L~~	~~99.5 % ammonium chloride~~	~~100 g~~	~~900 mL~~
ammonium chloride, 100 g/L	99.5 % ammonium chloride	100.5 g	1000 mL
~~Citric acid solution, 30 g/L~~	~~99.5 % citric acid~~	~~30 g~~	~~970 mL~~
citric acid solution, 30 g/L	99.5 % citric acid	30.2 g	1000 mL
~~Citric acid solution, 100 g/L~~	~~99.5 % citric acid~~	~~100 g~~	~~900 mL~~
citric acid solution, 100 g/L	99.5 % citric acid	100.5 g	1000 mL
~~Lactic acid, 5 % (v/v)~~	~~85 % lactic acid~~	~~50 mL~~	~~950 mL~~
lactic acid, 5 % (v/v)	85 % lactic acid	58.8 mL	941.2 mL
~~Phosphoric acid, 3 % (v/v)~~	~~85 % phosphoric acid~~	~~30 mL~~	~~970 mL~~
phosphoric acid, 3 % (v/v)	85 % phosphoric acid	35.3 mL	964.7 mL
~~Phosphoric acid, 10 % (v/v)~~	~~85 % phosphoric acid~~	~~100 mL~~	~~900 mL~~
phosphoric acid, 10 % (v/v)	85 % phosphoric acid	117.6 mL	882.4 mL
~~Sulfamic acid, 30 g/L~~	~~99 % sulfamic acid~~	~~30 g~~	~~970 mL~~
sulfamic acid, 30 g/L	99 % sulfamic acid	30.3 g	1000 mL
~~Sulfamic acid, 100 g/L~~	~~99 % sulfamic acid~~	~~101 g~~	~~899 mL~~
sulfamic acid, 100 g/L	99 % sulfamic acid	101 g	1000 mL
	~~Swimming pool chemicals~~ Swimming Pool Chemicals		
~~Sodium hypochlorite solution, 20 mg/L~~	~~technical grade sodium hypochlorite with 13 % active clorine~~	~~20 mg~~	~~980 mL~~
sodium hypochlorite solution, 20 mg/L	technical grade sodium hypochlorite with 13 % active chlorine	0.15 mL	999.85 mL
	Acids and Bases		
~~Hydrochloric acid solution, 3 % (v/v)~~	~~38 % hydrochloric acid~~	~~30 mL~~	~~970 mL~~
hydrochloric acid solution, 3 % (v/v)	38 % hydrochloric acid	78.9 mL	921.1 mL
~~Hydrochloric acid solution, 18 % (v/v)~~	~~38 % hydrochloric acid~~	~~180 mL~~	~~820 mL~~
hydrochloric acid solution, 18 % (v/v)	38 % hydrochloric acid	473.7 mL	526.3 mL
~~Potassium hydroxide, 30 g/L~~	~~90 % potassium hydroxide~~	~~33.33 g~~	~~967 mL~~
potassium hydroxide, 30 g/L	90 % potassium hydroxide	33.33 g	1000 mL
~~Potassium hydroxide, 100 g/L~~	~~90 % potassium hydroxide~~	~~111 g~~	~~889 mL~~
potassium hydroxide, 100 g/L	90 % potassium hydroxide	111.1 g	1000 mL

[2] *Reagent Chemicals, American Chemical Society ~~Specifications~~ Specifications,* ~~,~~American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeial and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

5.2.1.4 Citric acid solution, 30 g/L.
5.2.1.5 Citric acid solution, 100 g/L.
5.2.1.6 Lactic acid, 5 % (v/v).
5.2.1.7 Phosphoric acid, 3 % (v/v).
5.2.1.8 Phosphoric acid, 10 % (v/v).
5.2.1.9 Sulfamic acid, 30 g/L.
5.2.1.10 Sulfamic acid, 100 g/L.

5.3 *Swimming Pool Chemicals*—Sodium hypochlorite solution, 20 mg/L, prepared from technical grade sodium hypochlorite with about 13 % of active chloride.

5.4 *Acids and Bases:*
5.4.1 Hydrochloric acid solution, 3 % (v⁄v).
5.4.2 Hydrochloric acid solution, 18 % (v⁄v).
5.4.3 Potassium hydroxide, 100 g/L.
5.4.4 Potassium hydroxide, 30 g/L.

5.5 This test method may be used for exposing tile to any chemical substance 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, either to simulate service conditions or accelerate deterioration that is possible under expected service conditions, or bear some other meaningful relation to expected service conditions.

5.6 Hydrofluoric acid should not be used as a test substance because most ceramics are silicates and are quite readily attacked by this acid.

6. Samples

6.1 *Number of Test Specimens*—One defect-free test specimen that 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, take care to include all distinctive parts and more test specimens as necessary to incorporate all surface features.

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

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

6.4 The test specimens can be glazed or unglazed tile. If the ~~tile~~tiles are glazed, then apply the testing solutions to the glazed surface.

7. Procedure for Test Solution Application

7.1 *Application of the Test Solutions :*
~~7.1.1 Dry the test specimens thoroughly at 110 ± 5 °C before testing, and then cool the tile to room temperature.~~
7.1.1 The labeled test specimens are laid out on a table in a well-ventilated area. (**Warning—**Since this test method involves the use of concentrated acids and bases, take proper precautions for the handling of these chemicals, such as protective clothing and fume hoods.)
~~7.1.3 Transfer 20 mL of the testing solution to a test tube.~~
7.1.2 ~~Place the~~ Using a glass test tube or PVC tube, place approximately 5 mL of the test solution in contact with the surface of the ~~tile to be tested face down on the open end of the test tube.~~specimen. If the surface of the specimen is textured, using a non-reacting sealing agent such as plumber's putty or petroleum jelly around the outside of the tube may be necessary to prevent leaking.
~~7.1.5 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.~~
7.1.3 Carefully place the assembly on the table and leave undisturbed for 24 h.

7.2 *Removal of the Test ~~Solutions :~~ Solutions:*
7.2.1 After 24 h of contact between the test specimens and the test solution has expired, ~~again invert the assembly so that the test solution is contained in the test tube, and remove the test~~ remove the tube from the specimen and dispose of the testing solution properly.
7.2.2 Thoroughly rinse the specimens under running water ~~for a period of 10 min~~ to remove any residual testing solution. If needed, clean the surface with a soft bristle brush to remove test solutions.
7.2.3 Dry the specimens ~~thoroughly at 110 ± 5 °C, and cool~~ by heating in an oven adjusted to a minimum of 110 °C and not exceeding 160 °C for a minimum of 4 h (or such other time as has been established for the oven in use and the mass of the tiles being dried). Cool the specimens to room temperature before evaluation.