Designation: C 279 – 88 (Reapproved 2001)

Standard Specification for Chemical-Resistant Masonry Units[1]

This standard is issued under the fixed designation C 279; 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 specification covers solid, kiln fired brick and tile made from clay, shale, or mixtures thereof, suitable for indoor and outdoor use in masonry construction subjected to chemical environments.

1.2 The physical and chemical properties of brick and tile differ from supplier to supplier, mainly because their composition is determined by the source of raw materials. Regardless of the differences, brick and tile are considered to be of three types as follows:

1.2.1 *Type I*—For use where low absorption and high acid resistance are not major factors.

1.2.2 *Type II*—For use where lower absorption and higher acid resistance are required.

1.2.3 *Type III*—For use where minimum absorption and maximum acid resistance are required.

NOTE 1—*Types I, II,* and *III* may not differ significantly in thermal shock resistance. The suitability of a given brick, for a particular application should be determined at the time of purchase by agreement between the purchaser and the supplier.

NOTE 2—*Types I* and *III* were formerly designated Type "H'' and "L'' respectively.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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:*

C 20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water[2]

C 67 Test Methods of Sampling and Testing Brick and Structural Clay Tile[3]

C 397 Practice for Use of Chemically Setting Chemical-Resistant Silicate and Silica Mortars[3]

C 723 Practice for Chemical-Resistant Resin Grouts for Brick or Tile[3]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[4]

3. Physical Properties

3.1 *Strength*—The brick and tile when tested in accordance with Test Methods C 67 shall conform to the requirements for modulus of rupture (flexural strength) for the type specified, as prescribed in Table 1.

3.2 *Water Absorption*—The brick and tile when tested in accordance with Test Methods C 20 shall conform to the requirements for water absorption (based on the 2 h boil) for the type specified, as prescribed in Table 1.

3.3 *Sizes*—The sizes of the brick and tile shall be as specified by the purchaser. The length, width, and depth measurements of the brick or tile shall be within ±3 % of the specified dimensions when tested in accordance with Test Methods C 67.

3.4 *Warpage*—The brick and tile when tested in accordance with Test Methods C 67 shall conform to the requirements as shown in Table 2. (**Warning**—The above tolerances may not be consistent with the recommended mortar joint sizes contained in Practices C 397 and C 723. If brick or tile with tighter tolerances than those described in 3.3 or 3.4 are required, the purchaser shall negotiate such requirements with the manufacturer.)

3.5 *Surface Textures*—Brick or tile surfaces should be textured in order to promote better bonding. Texturing may be accomplished by scoring, wire cutting, matting, or other means consistent with a manufacturer's process. If texturing is done, the protrusion or indentation shall not exceed ⅛ in. (3 mm) in depth.

4. Significance and Use

4.1 The brick and tile covered herein are intended essentially for use in chemical environments where resistance to thermal shock may or may not be a consideration. The brick

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[2] *Annual Book of ASTM Standards,* Vol 15.01.

[3] *Annual Book of ASTM Standards,* Vol 04.05.

[4] *Annual Book of ASTM Standards,* Vol 14.02.

TABLE 1 Physical and Chemical Requirements for Brick and Tile

Designation	Modulus of Rupture (Brick or Tile Flatwise) min. psi (MPa)	Water Absorption Maximum % by 2 h Boiling Test		H_2SO_4 Solubility Maximum % Weight Loss
	Average of 5 Brick or Tile Low Individual	Average of 5 Brick or Tile High Individual		Average of 5 Brick or Tile
Type I	1250 (8.6) 1000 (6.9)	6.0	7.0	20
Type II	1250 (8.6) 1000 (6.9)	4.0	5.0	12
Type III	1250 (8.6) 1000 (6.9)	1.0	1.5	8

TABLE 2 Tolerances on Warpage

Minimum Face Dimensions, inches (mm)	Maximum Permissible Warpage, inches (mm)
8 and under (203) and under	3/32 (2.4)
over 8–12 (203 to 305), incl	1/8 (3.2)
over 12–16 (305 to 406), incl	5/32 (4.0)

and tile are normally used with chemical-resistant mortars.

5. Precision and Bias

5.1 A statement on precision and bias will be added at a later date.

6. Visual Inspection

6.1 The brick and tile shall be free of open surface laminations or cracks which would impair the performance of the construction.

NOTE 3—Open laminations or cracks within the brick or tile observed in the brick or tile cut or broken during testing, should be noted with their size and number indicated as part of the test report. If internal open laminations or cracks, or both, are reported, the purchaser shall determine the suitability of such brick or tile for his application.

6.2 *Black Heart*—Brick or tile when broken may have a dark area that has a steely appearance and is sharply delineated from the surrounding normal color of the brick. It is known as *black heart* or *black core*. Black heart is generally the result of the reduction of iron minerals during the firing process. Its presence, regardless of size, in brick or tile which otherwise meet the physical and chemical requirements of this specification, shall not be cause for rejection.

7. Sulfuric Acid Solubility Test

7.1 *Apparatus*:

7.1.1 *Crusher*, jaw-type.

7.1.2 *Sieves*, ¼-in. (6.3-mm) and No. 4 (4.75-mm) sieves (equivalent to 3-mesh and 4-mesh sieves, respectively, in the Tyler series), conforming to Specification E 11.

7.1.3 *Mechanical Shaking Device*, producing a lateral and vertical motion of the sieve, accompanied by a jarring action so as to keep the sample moving continuously over the surface of the sieve.

7.1.4 *Drying Oven*.

7.1.5 *Analytical Balance and Weights*, 0.01-g sensitivity.

7.1.6 *Desiccator*.

7.1.7 *Erlenmeyer Flask*, 750-mL, of heat-resistant and chemically resistant glass.

7.1.8 *Water-Cooled Condenser*.

7.1.9 *Hot Plate*.

7.1.10 *Fritted-Glass Funnel*, fine porosity.

7.1.11 *Suction Pump*.

7.2 *Preparation of Sample*—Prepare the sample from at least five masonry units selected in accordance with Test Methods C 67. Remove and discard the skin surface from a quarter of each unit selected and crush the remaining pieces in a jaw-type crusher, with the jaws set so that the grain size of the product ranges from material retained on a ¼-in. (6.3-mm) sieve to material passing a No. 4 (4.75-mm) sieve. Reduce this material either by mixing and quartering or by a mechanical splitter to approximately a 1000-g sample, and screen in a mechanical shaking device for 15 min, using the No. 3 [6.75-mm] and No. 4 [4.75-mm] sieves. Thoroughly mix the portion of the material passing the No. 3 [6.75-mm] sieve and remaining on the No. 4 [4.75-mm] sieve (Note 4), and then quarter down to obtain two 50-g samples. Dry these samples in a drying oven at 240°F (120°C) for at least 16 h, and then cool in a desiccator.

NOTE 4—Although it is recognized that some types of material tend to break down in a manner yielding various-shaped particles, no attempt shall be made at hand selection.

7.3 *Procedure*—Transfer each of the 50-g samples, weighed to the nearest 0.01 g, and 250 mL of sulfuric acid (sp gr 1.706, or 78 weight % 60° Baumé) to 750-mL Erlenmeyer flasks. Insert water-cooled condensers and boil on hot plates for 48 h (Note 5). Cool the flasks and contents sufficiently to permit handling, and decant the solutions through fritted-glass funnels with the aid of suction, retaining the samples in the flasks. Add about 250 mL of water to the flasks, boil for 10 min, and decant with the aid of suction through the same funnels as used previously. Repeat this washing procedure three times. On the fourth decantation of wash water, transfer the samples to the funnels, using hot water to aid in the transfer. Dry the funnels and contents in an oven at 240°F (120°C) for at least 16 h, and cool in a desiccator. Remove material from the funnels, brushing out the fines if necessary, and weigh to the nearest 0.01 g.

NOTE 5—Regulate the temperature of the hot plate so as to maintain a gentle boiling solution avoiding any considerable agitation of the sample. The use of a variable transformer in series with the hot plate is suggested.

7.4 *Calculation and Report*—Calculate the loss in weight as a percentage of the original weight. Make duplicate determinations and report an average of the two results to the nearest 0.1 %.

8. Keywords

8.1 absorption; acid resistance; acid solubility; ceramic; chemical-resistant; masonry; physical properties; solid brick