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AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
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Standard Specification for Industrial Chimney Lining Brick[1]

This standard is issued under the fixed designation C 980; 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.

ε[1] NOTE—Keywords were added editorially in June 1995.

1. Scope

1.1 This specification covers solid kiln fired brick made from clay, shale, or mixtures thereof suitable for use in masonry construction in contact with the chemicals present in flue gases found in industrial chimneys. These brick are normally used with chemical-resistant mortars.

1.2 The physical and chemical properties of chimney lining brick differ from supplier to supplier mainly because their composition is determined by the source of raw materials. Chimney lining brick, regardless of these differences, are considered to be of three types noted 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 lowest absorption and highest acid resistance are required.

NOTE 1—Types I, II, and III may not differ significantly in their resistance to thermal shock, and selection of brick type should be based upon their absorption and acid-resistant service requirements.

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]

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

3. Sulfuric Acid Boil Test

3.1 When tested in accordance with Section 6, the brick shall conform to the requirements for "Maximum Average Weight Loss by H_2SO_4 Boil Test" as shown in Table 1.

4. Physical Properties

4.1 *Compressive Strength*—When tested in accordance with Test Methods C 67, Section 6 (Compressive Strength), the brick shall conform to the requirements for "Minimum Compressive Strength" as shown in Table 1.

4.2 *Water Absorption*—When tested in accordance with Test Methods C 20, Section 10 (Water Absorption), the brick shall conform to the requirements for "Maximum Water Absorption by 2-h Boiling" as shown in Table 1.

4.3 *Sizes*—The sizes of brick shall be as specified by the purchaser. When tested in accordance with Test Methods C 67, Section 11 (Measurement of Size), the brick shall conform to the requirements for "Permissible Variations in Dimensions" as shown in Table 2.

4.4 *Warpage*—When tested in accordance with Test Methods C 67, Section 12 (Measurement of Warpage), the tolerance on warpage of the brick shall be as indicated in Table 2.

4.5 *Texture*—Scoring or matte texturing, or both, of the brick is recommended. However, no flutes or scores shall exceed ⅛ in. (3.0 mm) in height of protrusion or in depth.

5. Black Heart

5.1 Brick 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 that otherwise meet the physical and chemical requirements of this specification, shall not be cause for rejection.

6. Test for Solubility in Sulfuric Acid

6.1 *Significance and Use*—This test with sulphuric acid

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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 Properties and Chemical Requirements[A]

Designation	Minimum Compressive Strength, Gross Area, psi (MPa)		Maximum Water Absorption by 2-h Boiling, %		Maximum Average Weight Loss by H_2SO_4 Boil Test, %
	Average of 10	Individual	Average of 10	Individual	
Type I	8 500 (58.6)	8 000 (55.2)	6.0	7.0	20
Type II	10 000 (69.0)	9 000 (62.2)	4.0	5.0	12
Type III	12 000 (82.8)	10 000 (69.0)	1.0	1.5	8

[A]One complete set of tests for each of the above requirements shall be performed from brick randomly selected from every 100 000 bricks.

TABLE 2 Permissible Variations in Dimensions and Warpage[A]

Dimensions	Dimensions		
	Maximum Permissible Variations in Dimensions Between Largest and Smallest Brick in a Random Sampling of 10 Brick, %	Warpage	
		Maximum Face and Diagonal Dimensions, in. (mm)	Maximum Permissible Deviation, In. (mm)
Height	3	up to 9 ½ (241) incl	⅛ (3.0)
Length	5	...	...
Width	5		...

[A]One complete set of tests for each of the above requirements shall be performed from brick randomly selected from every 100 000 bricks.

represents an extremely severe one and may not be significant for chemical-resistant brick in less demanding applications. It can be assumed that sulphuric acid in this test concentration will be more corrosive than most other acids excluding those containing flourine. A similar test procedure using other chemicals may be more suitable for specific purposes. The performance of these other tests and appropriate qualifying data should be resolved between the purchaser and the seller.

6.2 *Apparatus*:

6.2.1 *Crusher*, jaw-type.

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

6.2.3 *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.

6.2.4 *Drying Oven*.

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

6.2.6 *Desiccator*.

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

6.2.8 *Water-Cooled Condenser*.

6.2.9 *Hot Plate*.

6.2.10 *Fritted-Glass Funnel*, fine porosity.

6.2.11 *Suction Pump*.

6.3 *Preparation of Sample*—Prepare the sample from at least five masonry units selected in accordance with Test Methods C 67. Remove 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 and No. 4 sieves. Thoroughly mix the portion of the material passing the No. 3 sieve and remaining on the No. 4 sieves (Note 2), 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 2—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.

6.4 *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 60° Baumé (78 weight %) into separate 750-mL Erlenmeyer flasks. Insert water-cooled condensers and boil on hot plates for 48 h (Note 3). 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 the 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 3—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.

6.5 *Calculations 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 %.

6.6 *Precision and Bias*—A statement on precision and bias will be added at a later date.

7. Keywords

7.1 absorption; acid resistance; acid solubility; ceramic; industrial chimney; masonry; physical properties; solid brick