CORES MAX 25%

Designation: C 216 – 92d

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race St. Philadelphia, Pa 19103
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Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)[1]

This standard is issued under the fixed designation C 216; 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.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This specification covers brick intended for use in masonry and supplying structural or facing components, or both, to the structure.

1.2 The property requirements of this standard apply at the time of purchase. The use of results from testing of brick extracted from masonry structures for determining conformance or non-conformance to the property requirements (Section 5) of this standard is beyond the scope of this standard.

1.3 The brick are prismatic units available in a variety of sizes, textures, colors, and shapes. This specification is not intended to provide specifications for paving brick (see Specification C 902).

1.4 Brick are manufactured from clay, shale, or similar naturally occurring earthy substances and subjected to a heat treatment at elevated temperatures (firing). The heat treatment must develop a fired bond between the particulate constituents to provide the strength and durability requirements of this specification (see firing, fired bond, and incipient fusion in Terminology C 43).

1.5 Brick may be shaped during manufacture by molding, pressing, or extrusion, and the shaping method may be used to describe the brick.

1.6 Three types of brick in each of two grades are covered.

1.7 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

C 43 Terminology Relating to Structural Clay Products[2]

C 67 Test Methods of Sampling and Testing Brick and Structural Clay Tile[2]

C 902 Specification for Pedestrian and Light Traffic Paving Brick[2]

E 835/E 835M Guide for Dimensional Coordination of Structural Clay Units, Concrete Masonry Units, and Clay Flue Linings[3]

3. Grades

3.1 Grades classifiy brick according to their resistance to damage by freezing when wet. Two grades of facing brick are covered and the requirements are shown in Table 1.

3.1.1 *Grade SW*—Brick intended for use where high and uniform resistance to damage caused by cyclic freezing is desired and where the brick may be frozen when saturated with water.

3.1.2 *Grade MW*—Brick which may be used where moderate resistance to cyclic freezing damage is permissible or where the brick may be damp but not saturated with water when freezing occurs.

4. Types

4.1 Three types of facing brick are covered:

4.1.1 *Type FBS*—Brick for general use in masonry.

4.1.2 *Type FBX*—Brick for general use in masonry where a higher degree of precision and lower permissible variation in size than permitted for Type FBS is required.

4.1.3 *Type FBA*—Brick for general use in masonry selected to produce characteristic architectural effects resulting from nonuniformity in size and texture of the individual units.

4.2 When the type is not specified, the requirements for Type FBS shall govern.

5. Physical Properties

5.1 *Durability*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table 1. When the grade is not specified, the requirements for Grade SW shall govern. Unless otherwise specified by the purchaser, brick of Grade SW shall be accepted instead of Grade MW. The saturation coefficient requirement shall be waived provided the average cold water absorption of a random sample of five brick does not exceed 8 %, no more than one brick of the sample exceeds 8 % and its cold water absorption must be less than 10 %. If brick are intended for use exposed to weather where the weathering index is less than 50, unless otherwise specified the requirements for water absorption (5-h boiling) and for saturation coefficient shall be waived. For the compressive strength requirements in Table 1, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

NOTE 1—The effect of weathering on brick is related to the weathering index, which for any locality is the product of the average annual

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[1] This specification is under the jurisdiction of ASTM Committee C-15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Clay Brick and Structural Clay Tile.

Current edition approved Nov. 15, 1992. Published January 1993. Originally published as C 216 – 46. Last previous edition C 216 – 92c.

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

[3] *Annual Book of ASTM Standards*, Vol 04.07.

TABLE 1 Physical Requirements

Designation	Minimum Compressive Strength psi, (MPa) gross area		Maximum Water Absorption by 5-h Boiling, %		Maximum Saturation Coefficient[A]	
	Average of 5 brick	Individual	Average of 5 brick	Individual	Average of 5 brick	Individual
Grade SW	3000 (20.7)	2500 (17.2)	17.0	20.0	0.78	0.80
Grade MW	2500 (17.2)	2200 (15.2)	22.0	25.0	0.88	0.90

[A] The saturation coefficient is the ratio of absorption by 24-h submersion in cold water to that after 5-h submersion in boiling water.

TABLE 2 Grade Recommendations for Face Exposures

Exposure	Weathering Index (Explanatory Note 1)	
	Less than 50	50 and greater
In vertical surfaces:		
In contact with earth	MW	SW
Not in contact with earth	MW	SW
In other than vertical surfaces:		
In contact with earth	SW	SW
Not in contact with earth	MW	SW

number of *freezing cycle days* and the average annual *winter rainfall* in inches (millimetres), defined as follows.[4]

A Freezing Cycle Day is any day during which the air temperature passes either above or below 32°F (0°C). The average number of freezing cycle days in a year may be taken to equal the difference between the mean number of days during which the minimum temperature was 32°F or below, and the mean number of days during which the maximum temperature was 32°F or below.

Winter Rainfall is the sum, in inches (millimetres), of the mean monthly corrected precipitation (rainfall) occurring during the period between and including the normal date of the first killing frost in the fall and the normal date of the last killing frost in the spring. The winter rainfall for any period is equal to the total precipitation less one tenth of the total fall of snow, sleet, and hail. Rainfall for a portion of a month is prorated.

Fig. 1 indicates general areas of the United States in which brick masonry is subject to severe, moderate, and negligible weathering. The severe weathering region has a weathering index greater than 500. The moderate weathering region has a weathering index of 50 to 500. The negligible weathering region has a weathering index of less than 50. The index for geographic locations near the 50 and 500-in. cycle lines should be determined by analysis of weather bureau local climatological summaries, with due regard to the effect of microclimatic conditions, especially altitude.

The recommended correlation between grade of facing brick, weathering index, and exposure is found in Table 2. The specifier may use these recommendations or use the grade descriptions and physical requirements along with use exposure and local climatological conditions to select grade.

5.2 *Freezing and Thawing*—The requirements specified in 5.1 for water absorption (5-h boiling) and saturation coefficient shall be waived provided a sample of five brick, meeting all other requirements, passes the freezing and thawing test as described in the Rating section of the freezing and thawing procedures of Test Methods C 67:

Grade SW — no breakage and not greater than 0.5 % loss in dry weight of any individual brick.

NOTE 2—The 50 cycle freezing and thawing test is specified only as an alternative when brick do not conform to either Table 1 requirements

[4] Data needed to determine the weathering for any locality may be found or estimated from tables of Local Climatological Data published by the National Oceanic and Atmospheric Administration.

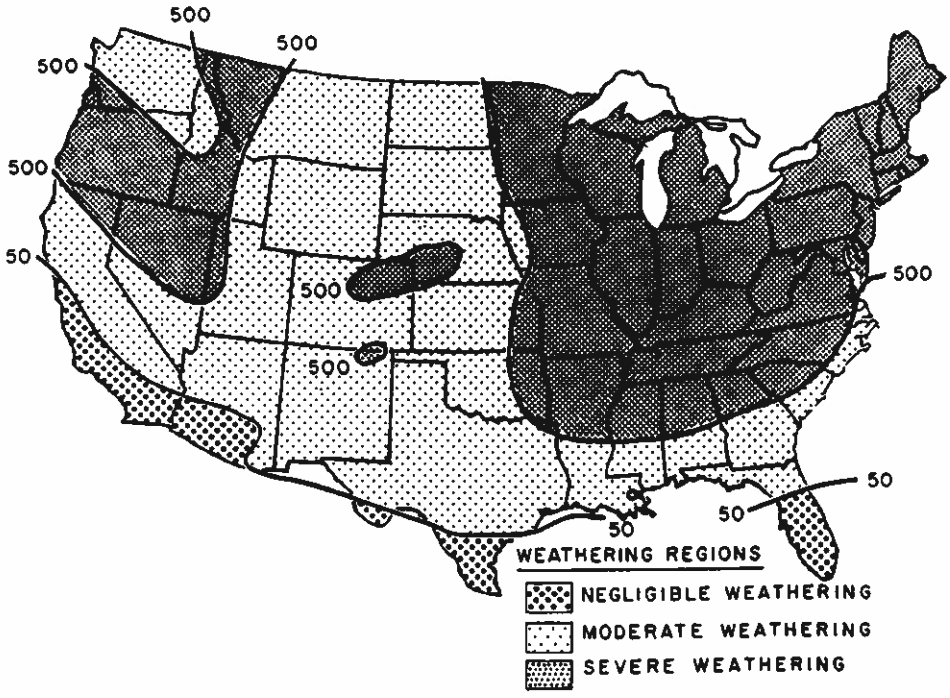

FIG. 1 Weathering Indexes in the United States

for maximum water absorption and saturation coefficient, or to the restrictive absorption requirements in 5.1.

5.3 *Strength*—When brick are required having strengths greater than prescribed by this specification, the purchaser shall specify the desired minimum compressive strength.

5.4 *Initial Rate of Absorption (IRA)*—Test results for IRA shall be determined in accordance with Section 9 of Test Methods C 67 and shall be furnished at the request of the specifier or purchaser. IRA is not a qualifying condition or property of units in this specification. This property is measured in order to assist in mortar selection and material handling in the construction process. See Note 3.

NOTE 3—*Initial Rate of Absorption (Suction)*—Both laboratory and field investigation have shown that strong and watertight joints between mortar and masonry units are not achieved by ordinary construction methods when the units as laid have excessive initial rates of absorption. Mortar that has stiffened somewhat because of excessive loss of mixing water to a unit may not make complete and intimate contact with the second unit, resulting in poor adhesion, incomplete bond, and water-permeable joints of low strength. IRA of the units is determined by the laboratory method described in Section 9 of Test Methods C 67. IRA in the field depends on the moisture content of the masonry unit and is determined in accordance with Section 14 of Test Methods C 67. Units having average field IRA exceeding 30 g/min·30 in.^{2} (30 g/min·194 cm^2) should have their IRA reduced below 30 g/min·30 in.^{2} prior to laying. They may be wetted immediately before they are laid, but it is preferable to wet them thoroughly 3 to 24 h prior to their use so as to allow time for moisture to become distributed throughout the unit.

6. Efflorescence

6.1 When the brick are tested in accordance with Test Methods C 67, the rating for efflorescence shall be: "not effloresced."

7. Material and Finish

7.1 Colors and textures produced by application of inorganic coatings to the faces of the brick are permissible with the consent of the purchaser, provided that evidence is furnished of the durability of the coatings. Brick that are colored by flashing or textured by sanding, where the sand does not form a continuous coating, are not considered as surface-colored brick for the purpose of this specification.

NOTE 4—When surface colored brick, other than sanded or flashed, are specified for *exterior* use, the purchaser should require that data be submitted showing that after 50 cycles of freezing thawing there is no observable difference in the applied finish when viewed from a distance of 10 ft (3.0 m) under an illumination of not less than 50 ft-candles (538 lx) by an observer with normal vision.

Service records of the performance of the particular coated brick in exterior locations may be accepted in place of the freezing and thawing test, upon consent of the purchaser.

7.2 The brick shall be free of defects, deficiencies, and surface treatments, including coatings, that would interfere with the proper setting of the brick or significantly impair the strength or performance of the construction.

7.3 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 3. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 5—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed percentage, listed in the second column from the left of Table 3 ranges up to 5 % for FBX, up to 10 % for FBS Smooth, and up to 15 % for FBS Rough. The remainder of the units that will be exposed in place, listed in the fifth column from the left, must conform to the chip sizes listed in the sixth and seventh columns from the left.

Example: Type FBS Smooth units will conform to the requirements of Table 3 if not more than 10 % of the units have edge chips greater than ¼ in. (6.4 mm) but less than 5/16 in. (7.9 mm) or corner chips greater than ⅜ in. (9.5 mm) but less than ½ in. (12.7 mm) and the remainder of the units, in this maximum case 90 % (100 % − 10 %) do not have edge chips greater than ¼ in. (6.4 mm) in from the edge nor corner chips greater than ⅜ in. (9.5 mm) in from the corner.

7.3.1 Other than chips, the face or faces shall be free of cracks or other imperfections detracting from the appearance of the designated sample when viewed from a distance of 15 ft (4.6 m) for Type FBX and a distance of 20 ft (6.1 m) for Types FBS and FBA.

7.4 Unless otherwise agreed upon between the purchaser and the seller, a delivery of brick may contain not more than 5 % brick, including broken brick, that do not meet the requirements for chippage and tolerances.

7.5 After brick are placed in usage the manufacturer or his agent shall not be held responsible for compliance of brick with the requirements of this specification for chippage and dimensional tolerances.

8. Texture and Color

8.1 The color, color range, and texture should be specified by the purchaser. Unless otherwise specified by the purchaser, at least one end of the majority of the individual brick shall have the same general texture and general color tone as the approved sample. The texture of the finished surfaces that will be exposed when in place shall conform to an approved sample consisting of not less than four stretcher brick, each representing the texture desired. The color range shall be indicated by the approved sample.

TABLE 3 Maximum Permissible Extent of Chippage From the Edges and Corners of Finished Face or Faces onto the Surface

Type	Percentage Allowed[A]	Chippage in in. (mm) in from		Percentage Allowed[A]	Chippage in in. (mm) in from	
		Edge	Corner		Edge	Corner
FBX	5 % or less	⅛–¼ (3.2–6.4)	¼–⅜ (6.4–9.5)	95 to 100 %	0–⅛ (0–3.2)	0–¼ (0–6.4)
FBS[B] (Smooth)	10 % or less	¼–5/16 (6.4–7.9)	⅜–½ (9.5–12.7)	90 to 100 %	0–¼ (0–6.4)	0–⅜ (0–9.5)
FBS[C] (Rough)	15 % or less	5/16–7/16 (7.9–11.1)	½–¾ (12.7–19.1)	85 to 100 %	0–5/16 (0–7.9)	0–½ (0–12.7)
FBA	to meet the designated sample or as specified by the purchaser, but not more restrictive than Type FBS (rough)					

[A] Percentage of exposed brick allowed in the wall with chips measured the listed dimensions in from an edge or corner.

[B] Smooth texture is the unbroken natural die finish.

[C] Rough texture is the finish produced when the face is sanded, combed, scratched, or scarified or the die skin on the face is entirely broken by mechanical means such as wire-cutting or wire-brushing.

TABLE 4 Tolerances on Dimensions

Specified Dimension, in. (mm)	Maximum Permissible Variation from Specified Dimension, plus or minus, in. (mm)	
	Type FBX	Type FBS
3 (76) and under	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.7)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)
Over 8–12 (203 to 305), incl	7/32 (5.6)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)

TABLE 5 Tolerances on Distortion

Maximum Dimension, in. (mm)	Maximum Permissible Distortion, in. (mm)	
	Type FBX	Type FBS
8 (203) and under	1/16 (1.6)	3/32 (2.4)
Over 8–12 (203 to 305), incl	3/32 (2.4)	1/8 (3.2)
Over 12–16 (305 to 406), incl	1/8 (3.2)	5/32 (4.0)

8.2 Where brick with other than one finished face and one finished end are required (brick with two finished faces or ends, or other types), all such special brick shall be explicitly specified by the purchaser.

NOTE 6—The manufacturer should be consulted for the availability of specialty units suitable for the intended purpose.

9. Size

9.1 *Size*—The size of brick shall be as specified by the purchaser. In a sample of ten brick selected to include the extreme range of color and size of brick to be supplied, no brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table 4. Tolerances on dimensions for Type FBA shall be as specified by the purchaser, but not more restrictive than FBS.

NOTE 7—For a list of modular sizes, see Guide E 835/E 835M. Sizes listed in this standard are not produced in all parts of the United States. Brick names denoting sizes may be regional and, therefore, may not be included in all reference books. Purchasers should ascertain the sizes of brick available in their locality and should specify accordingly, stating the desired dimensions (width by height by length).

9.2 *Warpage*—Tolerances for distortion or warpage of surfaces or edges intended to be exposed in use of individual brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table 5. Tolerances on distortion for Type FBA shall be as specified by the purchaser.

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the exposed face of the brick is 1/8 in. (3.2 mm) for Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 8—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

10. Coring and Frogging

10.1 *Coring*—Unless otherwise specified in the invitation for bids, brick may or may not be cored at the option of the seller. The net cross-sectional area of cored brick in any plane parallel to the surface containing the cores shall be at least 75 % of the gross cross-sectional area measured in the same plane. No part of any hole shall be less than 3/4 in. (19.1 mm) from any edge of the brick.

10.2 *Frogging*—Unless otherwise specified in the invitation for bids, one bearing face of each brick may have a recess or panel frog and deep frogs. The recess or panel frog shall not exceed 3/8 in. (9.5 mm) in depth and no part of the recess or panel frog shall be less than 3/4 in. (19.1 mm) from any edge of the brick. In brick containing deep frogs, frogs deeper than 3/8 in. (9.5 mm), any cross-section through the deep frogs parallel to the surface containing the deep frogs shall conform to the requirements of 10.1.

11. Sampling and Testing

11.1 For purposes of tests, brick that are representative of the commercial product shall be selected by a competent person appointed by the purchaser, the place or places of selection to be designated when the purchase order is placed. The sample or samples shall include specimens representative of the complete range of colors and sizes of the brick supplied or to be supplied. The manufacturer or the seller shall furnish specimens for tests without charge.

11.2 The brick shall be sampled and tested in accordance with Test Methods C 67.

NOTE 9—Unless otherwise specified in the purchase order, the cost of tests is typically borne as follows: If the results of the tests show that the brick do not conform to the requirements of this specification, the cost is typically borne by the seller. If the results of the tests show that the brick do conform to the requirements of this specification, the cost is typically borne by the purchaser.

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