



Designation: C 1405 – 01b

Standard Specification for Glazed Brick (Single Fired, Solid Brick Units)¹

This standard is issued under the fixed designation C 1405; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope *

1.1 This specification covers brick, having a ceramic glaze finish fused to the body during the same process as the unit body firing, that are intended for use in masonry and supplying structural or facing components, or both, to the structure. This specification does not cover double-fired glazed brick. Some double-fired decorative glazes have physical properties which vary from those of single-fired glazes due to the lower temperatures used in applying the decorative coating.

1.2 The property requirements of this specification apply at the time of purchase. The use of results from testing of brick extracted from masonry structures for determining conformance or nonconformance to the property requirements of this specification is beyond the scope of this specification.

1.3 Glazed brick are prismatic units available in a variety of sizes, textures, colors, and shapes. Glazed 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 shall develop a fired bond between the particulate constituents to provide the strength and durability requirements of this specification (see firing, fired bond, glaze, and incipient fusion in Terminology C 43).

1.4 Glazed brick are shaped during manufacture by molding, pressing, or extrusion, and the shaping method is a way to describe the brick.

1.5 Glazed brick are classified into one of two grades, one of two types, and one of two classes.

1.6 Opacity of the glaze is not required unless specified by the purchaser.

1.7 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this standard.

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

1.9 *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 43 Terminology of Structural Clay Products²

C 67 Test Methods for Sampling and Testing Brick and Structural Clay Tile²

C 1093 Practice for Accreditation of Testing Agencies for Unit Masonry²

E 84 Test Method for Surface Burning Characteristics of Building Materials³

2.2 NFPA Standard:

NFPA No. 255 Test for Surface Burning Characteristics of Building Materials⁴

2.3 UL Standard:

UL No. 723 Flammability Studies of Cellular Plastics and Other Building Materials Used for Interior Finishes⁵

2.4 ICBO Standard:

UBC No. 42-1 Test Method for Fire Hazard Classification of Building Material⁶

2.5 Federal Standard:

Federal Standard Test No. 141 Abrasion Resistance (Taber Abraser)⁷

3. Terminology

3.1 *Definitions*—Terms used in this specification are defined in accordance with Terminology C 43.

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

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² Annual Book of ASTM Standards, Vol 04.05.

³ Annual Book of ASTM Standards, Vol 04.07.

⁴ Available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

⁵ Available from Underwriters Laboratories, 1285 Walt Whitman Road, Melville, NY 11747.

⁶ Available from the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, CA 90601.

⁷ Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

*A Summary of Changes section appears at the end of this standard.

4. Classification

4.1 *Grades*—Grades classify glazed brick according to their permissible variation in face dimension as follows. When grade is not specified, the requirements for Grade S govern.

4.1.1 *Grade S (Standard)*, units for use where standard dimensional tolerances are desired.

4.1.2 *Grade SS (Select Sized)*, units for use where a higher degree of precision and lower permissible variation in size are desired.

4.2 *Types*—Two types of glazed brick are covered. When type is not specified, the requirements for Type I govern.

4.2.1 *Type I (Single-Faced Units)*, for general use where only one face is finished.

4.2.2 *Type II (Two-Faced Units)*, for use where two opposite faces are finished.

4.3 *Classes*—Two classes of glazed brick are covered. When class is not specified, the requirements for Class Exterior govern.

4.3.1 *Class Exterior*, for exterior applications.

4.3.2 *Class Interior*, for interior applications.

NOTE 1—Special brick shapes may be desired by the purchaser that do not meet all of the requirements of this specification (see 8.2.1). Consult the manufacturer for availability of special units and suitability for the intended purpose.

5. Physical Properties

5.1 *Durability*—Glazed brick shall conform to the physical properties requirements for the class specified as prescribed in Table 1 or in 5.1.1 or 5.1.2. For the compressive strength requirements, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

NOTE 2—The physical property requirements for durability are based upon correlation of these physical properties and freeze-thaw testing of units in standard production. They indicate durability. Conformance with these property requirements provides a reasonable level of confidence as to durability in lieu of freeze-thaw testing.

5.1.1 *Strength and Absorption Requirements Alternate*—The saturation coefficient requirement for Class Exterior does not apply, provided the average compressive strength of a random sample of five brick equals or exceeds 8000 psi (55.2 MPa) with no individual strength less than 7500 psi (51.8 MPa). Additionally, the 24-h cold water absorption of each unit shall not exceed 6.0 %.

5.1.2 *Freezing and Thawing Alternative*—The requirements for cold water absorption (5.1.1) and absorption and saturation coefficient (Table 1) for Class Exterior do not apply, provided a sample of five brick, meeting the strength requirements of

Table 1, passes the freezing and thawing test as described in the Rating Section of the Freezing and Thawing test procedures of Test Methods C 67.

NOTE 3—The 50 cycle freezing and thawing test is used as an alternative only when units do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the requirements of the Strength and Absorption Alternate in 5.1.1.

5.1.2.1 *Class Exterior: Weight Loss Requirement*—Not greater than 0.5 % loss in dry weight of any individual unit.

5.1.2.2 *Class Exterior: Breakage Requirement*—No individual unit separates into two or more significant pieces.

5.1.2.3 *Class Exterior: Cracking Requirement*—No individual unit develops a crack that exceeds, in length, the unit's least dimension.

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

5.3 *Initial Rate of Absorption (IRA)*—Determine results for IRA in accordance with Test Methods C 67 and furnish results at the request of the specifier or purchaser.

NOTE 4—*Initial Rate of Absorption (Suction)*—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.

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. Properties of Glaze

7.1 *Imperviousness*—When tested for imperviousness, 12.1.1, no stain that can be seen from a distance of 5 ft (1.5 m) shall remain on or beneath the surface, except a slight discoloration in the depressions on matt, stippled, or mottled glazes and in the crevices formed into the unit face(s) providing surface features.

7.2 *Resistance to Fading*—When tested for chemical resistance, 12.1.2, the color of the glaze shall not change from the approved sample.

7.3 *Resistance to Cracking*—When tested for crazing, 12.1.3, the glaze shall not craze, spall, or crack when subjected to one cycle of autoclaving.

7.4 *Flame Spread, Fuel Contribution, and Smoke Density*—Body and finish shall withstand temperatures up to 1900°F (878°C) without distortion or melting and rate “noncombustible.” When tested in accordance with the provisions of Test

TABLE 1 Physical Requirements

Designation	Minimum Compressive Strength, psi (MPa), Gross Area		Maximum Water Absorption by 24-h Cold, 7°	Maximum Saturation Coefficient ^A	
	Average of 5 Brick	Individual	Individual	Average of 5 Brick	Individual
Class Exterior	6000 (41.4)	5000 (34.8)	7.0	0.78	0.80
Class Interior	3000 (20.7)	2500 (17.2)			

^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.

Method E 84, glazed brick shall measure 0 flame spread, 0 fuel contribution, and 0 smoke density.

NOTE 5—This test method is similar to that specified in NFPA No. 255, UL No. 723, and UBC No. 42-1.

7.5 *Toxic Fumes*—Toxic fumes shall not be released from the body or glaze finish at temperatures up to 1900°F (878°C). No toxic fumes shall be released from the body or glaze finish when glazed brick are tested in accordance with Test Method E 84.

7.6 *Hardness and Abrasion Resistance*—Glaze shall resist scratching by ordinary glass or steel and be rated above five on the Mohs Hardness Scale. When tested for abrasion, under Wear Index Method No. 6192 of Federal Standard Test No. 141, using a Standard Taber Abraser Model CS-17 calibrated wheel and a 2.2 lb (1000 g) weight for 1000 wear cycles, the glazed face shall have a wear factor not in excess of 15.

7.7 *Opacity*—When opacity of the glaze is specified, discoloration of the body shall not be visible through the glaze when tested for opacity, 12.1.4.

NOTE 6—Opacity (7.7) is not a required property of clear and translucent glazes. The fading resistance (7.2) and hardness and abrasion resistance (7.6) properties are not required for metallic glazes. If those properties are important for glazes, consult the manufacturer for availability and suitability for the intended purpose.

8. Appearance, Color, and Texture

8.1 The body of the units shall be free of defects, deficiencies, and other imperfections that would interfere with the proper setting of the brick or significantly impair the strength or performance of the construction.

8.2 The color, color range, and texture shall be specified by the purchaser. The stretcher face of the brick and the exposed face(s) of shapes shall have the same general texture, color range, and glaze as the approved sample. The texture of the glazed surfaces shall conform to an approved sample of not less than four stretcher brick, each representing the texture desired. The color range shall be indicated by the approved sample.

8.2.1 Where brick are required having faces glazed other than those identified by type (Section 4), the purchaser shall specify faces to be glazed and the quantity of brick needed.

NOTE 7—Consult the manufacturer for the availability of specialty units suitable for the intended purposes.

8.3 The face(s) to be glazed shall be covered with a ceramic glaze of uniform quality. The glaze shall be free of chips, crazes, blisters, crawling, or other imperfections detracting from the appearance of the designated sample when viewed from a distance of 15 ft (4.57 m) for Class Exterior units and 5 ft (1.52 m) for Class Interior units.

8.4 Overspray of glazes onto adjacent faces of the units shall be regulated by the manufacturer. Residue resulting from the glazing operation shall not interfere with the proper setting of the units or significantly impair the strength or performance of the construction.

NOTE 8—Consult the manufacturer for the extent of overspray common in production. Should other limits on allowable overspray be desired, the manufacturer shall be consulted for availability.

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

8.6 After brick are handled by the purchaser, the manufacturer or the manufacturer’s agent shall not be held responsible for compliance of brick with the requirements of this specification for chippage and size.

9. Size

9.1 The dimensions of brick shall be as specified by the purchaser. In a sample of ten brick selected to represent the extreme range of sizes of brick to be supplied, no brick shall depart from the specified dimensions by more than the individual tolerance for the grade specified as prescribed in Table 2, Column A. The average size of ten brick sample shall be determined, and no brick in the job lot (delivered brick) shall vary from this average size by more than the individual tolerance for the grade specified as prescribed in Table 2, Column B. No individual brick in the job lot shall fall outside of the dimensional tolerances of Table 2.

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 grade specified as prescribed in Table 3.

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the exposed face of the brick is $\frac{3}{32}$ in. (2.4 mm).

TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation in Dimensions, in. (mm) plus or minus from:			
	Column A (for Specified Dimension)		Column B (for Average Brick Size in Job Lot Sample) ^A	
	Grade S	Grade SS	Grade S	Grade SS
3 (76) and under	$\frac{1}{16}$ (1.6)	$\frac{1}{16}$ (1.6)	$\frac{1}{16}$ (1.6)	$\frac{1}{16}$ (1.6)
Over 3-4 (76-102), incl	$\frac{3}{32}$ (2.4)	$\frac{1}{16}$ (1.6)	$\frac{1}{16}$ (1.6)	$\frac{1}{16}$ (1.6)
Over 4-6 (102-152), incl	$\frac{1}{8}$ (3.2)	$\frac{1}{16}$ (1.6)	$\frac{3}{32}$ (2.4)	$\frac{1}{16}$ (1.6)
Over 6-8 (152-203), incl	$\frac{5}{32}$ (4.0)	$\frac{1}{16}$ (1.6)	$\frac{3}{32}$ (2.4)	$\frac{1}{16}$ (1.6)
Over 8-12 (203-305), incl	$\frac{7}{32}$ (5.6)	$\frac{1}{16}$ (1.6)	$\frac{1}{8}$ (3.2)	$\frac{1}{16}$ (1.6)
Over 12-16 (305-406), incl	$\frac{9}{32}$ (7.1)	$\frac{1}{16}$ (1.6)	$\frac{3}{16}$ (4.8)	$\frac{1}{16}$ (1.6)

^A Lot size shall be determined by agreement between purchaser and seller. If not specified, lot size shall be understood to include all brick of one size and color in the job order.

TABLE 3 Tolerances on Distortion

Maximum Dimension, in. (mm)	Maximum Permissible Distortion, in. (mm)	
	Grade S	Grade SS
8 (203) and under	1/16 (1.6)	1/16 (1.6)
Over 8-12 (203-305) incl	3/32 (2.4)	3/32 (2.4)
Over 12-16 (305-406) incl	1/8 (3.2)	3/32 (2.4)

NOTE 9—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified grade. 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 are 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 is permitted to 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.

10.3 *Special Shapes*—Special shaped glazed brick are permitted to have coring and frogging configurations not conforming to the requirements of 10.1 and 10.2. Variations occur due to the method of forming and orientation of the shape in relation to the wall plane (see Note 1 and Note 7).

11. Sampling and Testing of Clay Bodies

11.1 For size, compressive strength, absorption, freeze-thaw, and efflorescence, sample and test brick in accordance with Test Methods C 67. Do not use brick tested for compliance with Section 12.

12. Sampling and Testing of Glazes

12.1 For the imperviousness, chemical resistance, crazing, and opacity tests, select a representative sample of five units for lots of 1 000 000 units, or fraction thereof. For larger lots, select five additional specimens from each additional 500 000 units, or fraction thereof.

NOTE 10—Unless otherwise specified in the purchase order, the cost of tests is typically borne as follows: If the results of tests show that the brick do not conform to the requirements of this specification, the cost typically is borne by the seller. If the results of the tests show that the brick do conform to the requirements of this specifications, the cost typically is borne by the purchaser.

12.1.1 *Imperviousness Test*—Apply permanent blue-black fountain pen ink liberally to the glazed surface of five dry specimens and allow to remain for 5 min. Wash the surface with a wet cloth and running water, and examine from a distance of 5 ft (1.52 m) for staining of the finish.

12.1.2 *Chemical Resistance Test*—Submerge an end portion of two whole specimens with the glazed surface exposed to a minimum depth of 1 1/2 in. (38.1 mm) in a 10 % solution of hydrochloric acid (HCl) for 3 h. Submerge the opposite end portions of the glazed surfaces of the same specimens similarly in a 10 % solution of potassium hydroxide (KOH) for 3 h. Maintain these solutions at a temperature of 60 to 80°F (15 to 27°C). Rinse, dry, and examine for changes of texture and changes of color, if any.

NOTE 11—A 10 % solution of HCl is prepared by volume using for example, 10 mL of concentrated HCl (12 N or 37.0 %) diluted to a volume of 100 mL with distilled water.

12.1.3 *Autoclaved Crazing Test*—Make the crazing test on three whole dry units previously tested for imperviousness of finish (12.1.1). Do not use specimens subjected to the chemical resistance test (12.1.2). Use an autoclave with sufficient capacity to contain all the units of the same texture, color, and size. Equip the apparatus with a safety valve, blowoff valve, thermometer, and pressure gage accurate within 2 % of the scale range, and a heater or other means of sufficient capacity to ensure constant steam pressure within the autoclave (**Warning**—See Appendix X1 for safety precautions pertaining to the use of autoclave equipment). Place the specimens loosely above the water in the autoclave at room temperature. After fastening the autoclave head in place, heat the water in the bottom from an external source. Keep the blowoff valve open until steam begins to escape, thereby expelling most of the air. After closing the blowoff valve, keep the water boiling and increase the steam pressure at a uniform rate until it reaches 150 psi (1.03 MPa) within a period of not less than 60 min nor more than 1 1/2 h. Apply sufficient heat to maintain a constant pressure of 150 ± 5 psi (1.03 ± 0.04 MPa) for an additional hour. Shut off the heater and release the steam pressure slowly in not less than 30 min by opening the blowoff valve. Loosen the autoclave head, but do not remove it, and permit the specimens to cool gradually to room temperature in a period not less than 3 h. Remove the specimens and rub permanent blue-black fountain pen ink upon the glazed surfaces to aid in the detection and examination of failures.

12.1.4 *Opacity Test*—Conduct the opacity test on three dry specimens by applying permanent blue-black fountain pen ink liberally to the body along a 2-in. (50.8-mm) length of the edge of the finished surface. After 5 min, examine the finish for opacity. When the same three specimens are to be subjected to both opacity and crazing test (12.1.3) make the opacity test first.

12.1.5 *Precision and Bias*—No information is presented about either the precision or bias of the test methods for measuring imperviousness, chemical resistance, crazing, or opacity because the test results are nonquantitative.

12.2 Sample and test brick for flame spread, fuel contribution, smoke density, and toxic fumes in accordance with Test Method E 84.

12.3 Sample and test brick for hardness and abrasion resistance in accordance with Federal Standard No. 141.

13. Keywords

13.1 brick; ceramic glaze; glaze properties; glaze test; physical properties; single fired

APPENDIX

(Nonmandatory Information)

X1. SAFETY PRECAUTIONS FOR AUTOCLAVE EQUIPMENT AND OPERATION

X1.1 The autoclave pressure gage should have a range from 0 to 600 psi (4.13 MPa) and should be maintained in accordance with Practice C 1093.

X1.2 If an automatic control is used, it should be maintained in proper working order.

X1.3 The safety valve should be maintained in accordance with Practice C 1093 and set to relieve the pressure at about 20 psi (0.13 MPa) above the 155 psi (1.07 MPa) maximum specified in 12.1.3. The discharge should be directed away from the operator.

X1.4 During the test, a thermometer always should be used as a safety pressure check.

X1.5 Precautions should be taken at all times for unexpected developments. The operator should be completely alert

and thoroughly familiar with all operations.

X1.6 Suitable gloves should be worn when loosening bolts and removing autoclave top at the completion of the test. The vent valve should be directed properly and the lid tilted so that escaping steam is discharged away from the operator.

X1.7 The return of the gage hand to the initial rest or starting point does not necessarily indicate zero pressure within the autoclave; there may still remain appreciable pressure.

X1.8 A few drops of kerosene placed in the vent valve about once a week will aid in keeping the needle clean and in good working condition.

X1.9 All additional safety precautions, as contained in the autoclave manufacturer's literature and specific operating instructions, should be carefully observed at all times.

SUMMARY OF CHANGES

Committee C15 has identified the location of selected changes to this standard since C 1405–01a that may impact the use of this standard.

(1) Paragraphs 4.1.1 and 4.1.2 were revised to refer to unit dimensions rather than mortar joint dimensions.

(2) Paragraph 4.3 was modified to delete the default to Class Exterior.

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