Designation: C 126 – 99

Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units[1]

This standard is issued under the fixed designation C 126; 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.

1. Scope

1.1 This specification covers structural clay load-bearing facing tile and facing brick and other "solid masonry units" made from clay, shale, fire-clay, or mixtures thereof, with or without the addition of grog or other mixtures, having a finish consisting of a ceramic glaze fused to the body at above 1500°F (655°C) making them inseparable, excluding natural salt-glazed ware. Two grades, based on permissible variation in face dimensions, and two types are covered, as follows:

1.1.1 *Grade S (select)*, for use with comparatively narrow mortar joints.

1.1.2 *Grade SS (select sized or ground edge)*, for use where variation of face dimension must be very small.

1.1.3 *Type I (single-faced units)*, for general use where only one finished face will be exposed.

1.1.4 *Type II (two-faced units)*, for use where two opposite finished faces will be exposed.

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

1.3 Brick and tile covered by this specification are manufactured from clay, shale, or similar naturally occurring substances and subjected to a heat treatment at elevated temperatures (firing). The heat treatment must develop sufficient fired bond between the particulate constituents to provide the strength requirements of this specification. (See firing and fired bond in Terminology C 43.)

1.4 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 the standard.

1.5 The following precautionary caveat pertains only to the test portion (Section 16) of this specification. *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 Products[2]

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

E 84 Test Method for Surface Burning Characteristics of Building Materials[3]

2.2 *National Fire Protection Association Standard:*[4]

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

2.3 *Underwriters Laboratories, Inc. Standard:*[5]

UL No. 723 Flammability Studies of Cellular Plastics and other Building Materials used for Interior Finishes

2.4 *International Conference of Building Officials Standard:*[6]

UBC No. 8-1 Test Method for Fire Hazard Classification of Building Material

2.5 *Government Standard:*[7]

Federal Standard Test No. 141

3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 *Grade*—When the grade is not specified, the requirements for Grade S shall govern.

3.1.2 *Type*—When the type is not specified, the requirements for Type I shall govern.

3.1.3 *Sizes and Shapes*— The sizes and shapes shall be specified in accordance with Section 9.

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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.

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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, Inc., 333 Pfingsten Rd., Northbrook, IL 60062.

[6] Available from the International Conference of Building Officials, 5360 S. Workman Mill Rd., Whittier, CA 90601.

[7] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

3.1.4 *Color and Texture of Finish*—The color and texture of the finish shall be specified in accordance with Section 8.

3.1.5 *Back Surfaces*— Unless otherwise specified, smooth, scored, combed, or roughened unglazed backs and smooth unselected glazed backs or a mixture thereof, are furnished. When plaster is to be applied, the back surface shall be specified in accordance with Section 12.

3.1.6 *Coring*—Unless otherwise specified, either standard or special duty units as prescribed in Section 13 are furnished.

3.1.7 *Opacity*—Where ceramic glazed units are not specified as opaque, they need not meet the requirements for opacity prescribed in 7.2.

3.1.8 *Exterior Use*— Where ceramic glazed units are required for exterior use, the manufacturers shall be consulted for material suitable for this purpose.

NOTE 1—The requirements included in this specification do not cover minimum criteria for durability of units exposed to exterior environments.

4. Description of Units

4.1 Units are multicored, hollow, or uncored, as follows:

4.1.1 *Solid Masonry Unit (multicored or uncored)* is a masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 % or more of its gross cross-sectional area measured in the same plane.

4.1.2 *Hollow Masonry Unit* is a masonry unit whose net cross-sectional area in any plane parallel to the bearing surface is less than 75 % of its gross cross-sectional area measured in the same plane.

5. Compressive Strength

5.1 The compressive strengths (based on gross area) of the units shall be not less than the values prescribed in Table 1.

6. Workmanship, Finish, and Appearance

6.1 The body of the units shall be free of cracks or other imperfections which would impair the strength or durability of the masonry.

6.2 Unless otherwise agreed upon between the purchaser and the seller, a delivery of brick or tile shall not contain more than 3 % brick or tile that are chipped, cracked or broken.

6.3 The finished face (one face of stretcher units and the finished faces of shapes) that will be exposed when in place 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 finished wall when viewed from a distance of 5 ft (1.52 m) at right angles from the wall.

NOTE 2—The purchaser or his authorized representative shall be accorded opportunity for sampling and inspecting units at the place of manufacture, prior to shipment. At least 10 days from the time of sampling should be allowed for completion of the tests. 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 does 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 does conform to the requirements of this specification, the cost is typically borne by the purchaser.

TABLE 1 Compressive Strengths of Units

NOTE—Special duty units are available from various manufacturers where higher compressive strengths are required.

Direction of Coring	Minimum Average of Five Tests, psi (MPa)	Individual Minimum, psi (MPa)
Vertical	3 000 (20.7)	2 500 (17.2)
Horizontal	2 000 (13.8)	1 500 (10.3)

7. Properties of Finish

7.1 *Imperviousness*— After the imperviousness test, no stain 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 finishes.

7.2 *Opacity*—Where opacity of finish is desired and so specified, discoloration of the body shall not be visible through the glaze in the opacity test. Clear ceramic glazes and special decorative glazes shall not be required to meet this requirement.

7.2.1 *Resistance to Fading*—The color of the glaze shall not change in the chemical resistance test. Finishes of metallic or special decorative glazes shall not be required to meet this requirement.

7.2.2 *Resistance to Crazing*—The glaze shall not craze, spall, or crack when subjected to one cycle of autoclaving in the crazing test.

7.2.3 *Flame Spread, Fuel Contribution and Smoke Density*—Body and finish must withstand temperatures up to 1900°F (878°C) without distortion or melting and rate“ noncombustible.” When tested in accordance with the provisions of Test Method E 84, structural facing tile shall measure 0 flame spread, 0 fuel contribution, and 0 smoke density. This test method is similar to that specified in NFPA No. 255, UL No. 723, and UBC No. 8-1.

7.2.4 *Toxic Fumes*— Toxic fumes will not be released from the body or glaze finish at temperatures up to 1900°F, and when tested under Test Method E 84.

7.2.5 *Hardness and Abrasion Resistance*—Glaze must 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 (Federal Standard Test No. 141), using a standard Taber Abraser Model CS-17 calibrase wheel and a 1000 g weight for 1000 wear cycles, the glazed face shall have a wear factor not in excess of 15. Finishes of metallic or special decorative glazes shall not be required to meet this requirement.

8. Color and Texture

8.1 The textures shall be mottled, stippled, or smooth as specified and the color of the finished surface shall be indicated by a sample consisting of not less than three stretcher units representing the range of shades.

9. Sizes and Shapes

9.1 The face sizes of ceramic glazed units and fittings therefore shall be as specified.

NOTE 3—The sizes shown in Table 2 are standard in the industry for single-faced units (Type I). Two-faced units (Type II) are standard in the industry, in 3¾-in. (95.3-mm) and 5¾-in. (146-mm) thickness only.

10. Number of Cells

10.1 Requirements for number of cells apply to hollow units

TABLE 2 Size of Single-Faced Units

Series Designation	Specified Face Dimensions		Specified Thickness, in. (mm)	
	Height, in. (mm)	Length, in. (mm)		
4*S*	2⅜ (60.3)	7¾ (196.9)	1¾or 3¾	(44.5 or 95.3)
4*D*	5$^{1}/_{16}$ (128.6)	7¾ (196.9)	1¾, 3¾, 5¾, or 7¾	(44.5, 95.3, 146.1, 196.9)
6*P*	3¾ (95.3)	11¾ (298.5)	1¾, 3¾, 5¾, or 7¾	(44.5, 95.3, 146.1, 196.9)
6*T*	5$^{1}/_{16}$ (128.6)	11¾ (298.5)	1¾, 3¾, 5¾, or 7¾	(44.5, 95.3, 146.1, 196.9)
6*M*	5¾ (146.1)	11¾ (298.5)	1¾, 3¾, 5¾, or 7¾	(44.5, 95.3, 146.1, 196.9)
8*W*	7¾ (196.9)	15¾ (400.1)	1¾ or 3¾	(44.5 or 95.3)

only (see 4.1.2). Cells are hollow spaces enclosed within the perimeter of the exterior shells having a minimum dimension of not less than ½ in. (12.7 mm) and a cross-sectional area greater than 1½ in.^{2} (9.7 cm^2). Hollow units of 6-in. (152.4 mm) and 8-in. (203.2 mm) thickness shall have not less than 2 cells or rows of cells in the direction of wall thickness.

10.2 Double-shell tile shall be considered as having one additional cell in the direction of wall thickness if either:

10.2.1 The combined width of the voids between exterior and interior shells on both sides of the tile is not less than ½ in. (12.7 mm) and the combined thickness of the short webs between inner and outer shells is not greater than that of the long transverse webs holding the inner shells, or

10.2.2 The combined thickness of the inner and outer shells on each side of the tile is not less than 1 in. (25.4 mm).

10.3 The face shells of single-shell tile with multicored or solid-face shells at least 1½ in. (38.1 mm) in thickness on both sides of the tile shall be considered as one additional cell in wall thickness, provided the volume of the cores in multicored shells does not exceed 35 % of the gross volume of the face shell and the minimum distance from perimeter of core to either side of shell is not less than ⅜ in. (9.5 mm).

11. Shell and Web Thickness

11.1 *Multicored Units*— The minimum distance from the perimeter of core to the outer surface of the shell of multicored units shall be not less than ¾ in. (19 mm).

11.2 The thickness of connecting webs between cores of multicored units, multicored shells, or supplementary cores of hollow units, shall be not less than ¼ in. (6.4 mm).

11.3 *Hollow Units*— The average overall thickness of the shells, measured between the inner and extreme outer surfaces of vertical-cell hollow units, shall be not less than ¾ in. (19 mm). The thickness of the webs shall be not less than ½ in. (12.7 mm).

11.4 The average over-all thickness of the side (face) shells, measured between the inner and extreme outer surfaces of horizontal-cell hollow units, shall be not less than ¾ in. (19 mm). The net thickness of the top and bottom shells shall be not less than ½ in. (12.7 mm); that is, when the top and bottom shells are scored, the over-all thickness of the top and bottom shells shall be not less than ½ in. plus the depth of the grooves. The thickness of the webs shall be not less than ½ in.

11.5 The horizontal width of any cell in horizontal-cell hollow units shall not exceed 4½ times the average over-all thickness of either the upper or lower bearing shell.

12. Tolerances on Dimensions

12.1 *Face Dimension Tolerances*—The total variation in the finished face dimensions of units shall be not more than the amounts shown in Table 3.

12.2 *Bed-Depth Dimension Tolerances*—The total variation in the bed-depth (through the wall) dimension of units shall be not more than the amount shown in Table 4.

12.3 *Distortion Tolerances*—The maximum permissible deviation of the plane and the edges of the face of individual units from a plane surface and from a straight line, respectively, shall not exceed the amount shown in Table 5.

13. Plaster Base Finish

13.1 Unless otherwise specified by the purchaser, smooth, scored, combed or roughened-back units or a mixture thereof are furnished.

13.2 When smooth, at least 90 % of the tile area shall be free of glaze and the average absorption shall be not less than 5 %, unless acceptable plaster adhesion bond test data is provided.

13.3 When scored, each groove shall be dovetailed and shall be not less than $^{1}/_{16}$ in. (1.6 mm) nor more than ¼ in. (6.4 mm) in depth, and not more than 1 in. (25.4 mm) in width. The area covered by the grooves shall not exceed 50 % of the area of the scored faces.

13.4 When combed, the tile shall be scarified, prior to burning, by mechanical means which shall make scarifications on the surface of the tile not less than $^{1}/_{16}$ in. (1.6 mm) nor more than ⅛ in. (3.2 mm) in depth, and not more than ¼ in. (6.4 mm) apart. When roughened, the die skin on the face of the tile

TABLE 3 Permissible Variations in Face Dimensions

NOTE 1—Permissible variations for units having dimensions more than ¼ in. (6.4 mm) greater than shown in this table shall be the same as for the next larger dimension.

NOTE 2—Other sizes are available conforming to the provisions of Grade SS units; however, the standard face dimensions are permitted to be $^{1}/_{16}$ in. less than the specified face dimensions listed in Table 3 for Grade S (or Grade SS) Units.

Specified Face Dimension, Return or Reveal (Height, Length), in. (mm)	Maximum Difference Between Dimension of Any Unit and the Specified Dimension		Maximum Difference Between Largest and Smallest Unit in One Lot,[A] in. (mm)
	If Larger, in. (mm)	If Smaller, in. (mm)	
Grade S Units			
2⅜ (60.3)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)	$^{3}/_{32}$ (2.4)
3¾ (95.3)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)	$^{3}/_{32}$ (2.4)
5$^{1}/_{16}$ (128.6)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)	$^{3}/_{32}$ (2.4)
5¾ (146.1)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)	$^{3}/_{32}$ (2.4)
7¾ (196.9)	$^{1}/_{16}$ (1.6)	⅛ (3.2)	$^{5}/_{32}$ (4.0)
11¾ (198.5)	$^{1}/_{16}$ (1.6)	$^{5}/_{32}$ (4.0)	$^{3}/_{16}$ (4.8)
Grade SS—Select Sized or Ground-Edge Units Only			
7¾ (196.9)	$^{1}/_{16}$ (1.6)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)
15¾ (400.1)	$^{1}/_{16}$ (1.6)	$^{1}/_{16}$ (1.6)	$^{3}/_{32}$ (2.4)

[A] Size of lot shall be determined by agreement between the purchaser and the seller.

TABLE 4 Permissible Variation in Bed Depth Dimensions

NOTE 1—Permissible variations for units having dimensions more than ¼ in. (6.4 mm) greater than shown in this table shall be the same as for the next larger dimension.

NOTE 2—No bed depth greater than 3¾ in. is made in trim shades or two-faced units of ceramic glaze.

NOTE 3—Variation in the bed depth of individual units is controlled by the limitations on distortion. The thickness of a unit shall be considered either the maximum or minimum thickness, whichever is the farther from the specified dimension.

Specified Bed Depth Dimension (Wall Thickness), in. (mm)	Maximum Difference Between Dimension of Any Unit and the Specified Dimension		Maximum Difference Between Largest and Smallest Unit in One Lot, in. (mm)[A]
	If Larger, in. (mm)	If Smaller, in. (mm)	
Type I—Single-Faced Units			
1¾ (44.5)	⅛ (3.2)	⅛ (3.2)	⅛ (3.2)
3¾ (95.3)	⅛ (3.2)	3⁄16 (4.7)	3⁄16 (4.7)
5¾ (146.0)	⅛ (3.2)	¼ (6.4)	¼ (6.4)
7¾ (196.9)	⅛ (3.2)	5⁄16 (7.9)	5⁄16 (7.9)
Type II—Two-Faced Units			
3¾ (95.3)	⅛ (3.2)	⅛ (3.2)	⅛ (3.2)
5¾ (146.0)	⅛ (3.2)	⅛ (3.2)	⅛ (3.2)

[A] Size of lot shall be determined by agreement between the purchaser and the seller.

TABLE 5 Permissible Distortion

NOTE—When convex units are laid upon a plane surface, the apparent variation is greater than the actual variation from the plane of the unit. Distortion tolerances for units having dimensions more than ¼ in. (8.4 mm) greater than shown in this table shall be the same as for the next larger dimension.

Specified Face Dimensions (Height and Length), in. (mm)	Grade	Maximum Permissible Distortion, in. (mm)
2⅜ × 7¾ (60.3 × 196.9)	S	1⁄16 (1.6)
5 1⁄16 × 7¾ (128.6 × 196.9)	S	1⁄16 (1.6)
5 1⁄16 × 11¾ (128.6 × 298.5)	S	1⁄16 (1.6)
3¾ × 11¾ (95.3× 298.5)	S	1⁄16 (1.6)
5¾ × 11¾ (146.1× 298.5)	S	1⁄16 (1.6)
7¾ × 11¾ (196.9× 298.5)	S	5⁄32 (4.0)
7¾ × 15¾ (196.9× 400.1)	SS	3⁄32 (2.4)

shall be entirely broken by mechanical means, such as wire cutting or wire brushing. (The die skin is visible within the cells of the tile.)

14. Coring

14.1 When special-duty units are specified, the units are either multicored or uncored. Multicored tile contain hollow spaces (cores) which are enclosed within the perimeter of the exterior shells and have a cross-sectional area of not more than 1½ sq in. Unless otherwise specified, type and direction of coring are optional with each manufacturer.

14.2 The distance from the perimeter of the core of multicored units to the face of the tile shall be not less than ¾ in. (19 mm) except in tile designed to be split for fractional lengths where the distance from the face of the tile to the perimeter of the kerfing cores shall be not less than ½ in. (12.7 mm).

14.3 Unless special duty units are definitely required, maximum percentage of coring is fixed by the requirements of Sections 9 and 10.

14.4 Percentage of coring shall be taken as the percentage of the gross volume removed by coring. Gross volume of the unit shall be determined to the outside of the scoring, but the material removed by scoring shall not be considered as part of the coring.

TEST METHODS

15. Test Specimens

15.1 For the imperviousness, chemical resistance, crazing, opacity, and compression tests, at least ten units shall be selected by the purchaser or his authorized representative. Ten stretcher units shall be tested for a lot of 10 000 units or fraction thereof; for larger lots, ten additional units are permitted to be tested for each 30 000 units or fraction thereof. When less than 1 000 units of any size are ordered, tests of these units shall not be required.

16. Test Methods

16.1 *Compressive Strength Test*—Make compressive strength tests on five specimens in accordance with Test Methods C 67. Do not use the specimens used in the crazing test (15.4) in the compressive strength test.

16.2 *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.

16.3 *Chemical Resistance Test*—Submerge an end portion of two whole specimens with the glazed surface exposed to a minimum depth of 1½ 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 color, if any.

16.4 *Autoclave Crazing Test*—Make the crazing test on three whole dry units previously tested for imperviousness of finish (16.2). Do not use specimens subjected to the chemical resistance test (16.3). The autoclave shall have sufficient capacity to contain all the units of the same texture, color, and size. The apparatus shall be equipped 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**—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.) 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 1½ h. Apply sufficient heat to maintain a constant steam pressure of 150 ± 5 psi 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, 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. (**Warning**—See Appendix X1 for safety precautions pertaining to the use of autoclave equipment.)

16.5 *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 tests (16.4), make the opacity test first.

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

17. Keywords

17.1 brick; ceramic glaze; clay; glaze properties; masonry construction; physical properties; shale; tile

APPENDIX

(Nonmandatory Information)

X1. SAFETY PRECAUTIONS FOR AUTOCLAVE EQUIPMENT AND OPERATION

X1.1 The autoclave pressure gage should have a range from zero to 600 psi (4.13 MPa) and should be tested regularly.

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

X1.3 The safety valve should be tested regularly and set to relieve the pressure at about 20 psi (0.13 MPa) above the 155 psi (1.03 MPa) maximum specified in 16.4. The discharge should be directed away from the operator.

X1.4 During the test a thermometer should always 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 properly directed and the lid tilted so that escaping steam is discharged away from the operator.

X1.7 It should be remembered that for many autoclave pressure gages now in use, 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 kerosine 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.