



Designation: C652 – 17

Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)¹

This standard is issued under the fixed designation C652; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers hollow building brick and hollow facing brick made from clay, shale, fire clay, or mixtures thereof, and fired to incipient fusion. Four types of hollow brick in each of two grades and two classes are covered. In this specification, the term hollow brick shall be understood to mean hollow clay masonry units whose net cross-sectional area (solid area) in any plane parallel to the surface, containing the cores, cells, or deep frogs, is less than 75 % of its gross cross-sectional area measured in the same plane (see 4.3). This specification does not cover brick intended for use as paving brick (see Specification C902).

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 (Section 6) of this standard is beyond the scope of this specification.

1.3 Brick covered by this specification are ceramic products manufactured primarily from clay, shale, or similar naturally occurring substances and subjected to a heat treatment at elevated temperatures (firing). The heat treatment shall develop sufficient fired bond between the particulate constituents to provide the strength and durability requirements of this specification. Additives or recycled materials are permitted to be included at the option of the manufacturer. (See “firing” and “firing bond” in Terminology C1232.)

1.3.1 This specification and its individual requirements shall not be used to qualify or corroborate the performance of a masonry unit made from other materials, or made with other forming methods, or other means of binding the materials.

1.4 Hollow brick differ from unglazed structural clay tile (Specifications C34 and C212) and solid brick (Specifications C62 and C216). Hollow brick require greater shell and web

thicknesses and higher minimum compressive strength than structural clay tile, but permit greater void area and lesser distance from exposed edge to core hole than solid brick. Therefore, environmental and structural performance may be different in elements constructed of hollow brick from those constructed of structural clay tile or solid brick.

1.5 The text of this specification 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 specification.

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 *ASTM Standards*:²

C34 Specification for Structural Clay Load-Bearing Wall Tile

C62 Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)

C67 Test Methods for Sampling and Testing Brick and Structural Clay Tile

C212 Specification for Structural Clay Facing Tile

C216 Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

C902 Specification for Pedestrian and Light Traffic Paving Brick

C1232 Terminology of Masonry

3. Terminology

3.1 *Definitions*—For definitions relating to masonry and hollow brick, refer to Terminology C1232.

4. Classification

4.1 *Grades*—Grades classify brick according to their resistance to damage by freezing when saturated at a moisture

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

content not exceeding the 24-h cold water absorption. Two grades are covered and the grade requirements are given in Section 6.

NOTE 1—Although grade is associated with resistance to deterioration under freeze/thaw exposures, freeze/thaw resistance of a clay brick unit is also affected by the properties of the surrounding materials, the construction details, and the overall environment in which the clay unit is placed; each of which may influence exposure to moisture and freezing conditions. Brick masonry should be detailed to minimize saturation or near-saturation of the units in freezing conditions. Measurement of moisture content of brick in buildings indicates that, when the building is designed and constructed to reduce water penetration, the 24-h cold water absorption is unlikely to be exceeded. See Specification C216, Appendix for additional information regarding freeze/thaw durability in service.

4.1.1 *Grade SW*—Hollow brick intended for use where a high and uniform degree of resistance to frost action and disintegration by weathering is desired and the exposure is such that the hollow brick may be frozen when permeated with water.

4.1.2 *Grade MW*—Hollow brick intended for use where a moderate and somewhat nonuniform degree of resistance to frost action is permissible or where they are unlikely to be permeated with water when exposed to temperatures below freezing.

4.2 *Types*—Four types of hollow brick are covered:

4.2.1 *Type HBS*—Hollow brick for general use in masonry.

4.2.2 *Type HBX*—Hollow brick for general use in masonry where a higher degree of precision and lower permissible variation in size than permitted for Type HBS is required.

4.2.3 *Type HBA*—Hollow brick for general use in masonry selected to produce characteristic architectural effects resulting from nonuniformity in size and texture of the individual units.

4.2.4 *Type HBB*—Hollow brick for general use in masonry where a particular color, texture, finish, uniformity, or limits on cracks, warpage, or other imperfections detracting from the appearance are not a consideration.

4.2.5 When the type is not specified, the requirements for Type HBS shall govern.

4.3 *Class*—Two classes of hollow brick are covered:

4.3.1 *Class H40V*—Hollow brick intended for use where void areas or spaces greater than 25 %, but not greater than 40 %, of the gross cross-sectional area of the unit measured in any plane parallel to the surface containing the cores, cells, or deep frogs are desired. The void spaces, the web thicknesses, and the shell thicknesses shall comply with the requirements of Section 10 on Coring and Frogging.

4.3.2 *Class H60V*—Hollow brick intended for use where larger void areas are desired. The sum of these void areas shall be greater than 40 %, but not greater than 60 %, of the gross cross-sectional area of the unit measured in any plane parallel to the surface containing the cores, cells or deep frogs. The void spaces, the web thicknesses, and the shell thicknesses shall comply with the requirements of Section 10 on Coring and Frogging and to the minimum requirements contained in Table 1 (see Fig. 1).

4.3.3 When the class is not specified, the requirements of Class H40V shall govern.

TABLE 1 Class H60V—Hollow Brick Minimum Thickness of Face Shells and Webs, in. (mm)

| Nominal Width of Units | Face Shell Thicknesses | | End Shells or End Webs |
|------------------------|------------------------|-----------------------|------------------------|
| | Solid | Cored or Double Shell | |
| 3 and 4 (76 and 101) | ¾ (19.05) | ... | ¾ (19.05) |
| 6 (152) | 1 (25.4) | 1½ (38) | 1 (25.4) |
| 8 (203) | 1¼ (32) | 1½ (38) | 1 (25.4) |
| 10 (254) and greater | 1¼ (32) | 1⅝ (41) | 1 (25.4) |

5. Materials and Manufacture

5.1 The body of all hollow brick shall be of clay, shale, fire clay, or mixtures of these materials, with or without admixtures, burned to meet the requirements of this specification. Any coloring or other materials added to the clay shall be suitable ceramic materials and shall be well distributed throughout the body.

5.2 Colors and textures produced by application of inorganic coatings to the faces of the brick shall be permitted 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, shall not be considered as surface-colored brick for the purpose of this specification.

NOTE 2—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.

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

5.4 If any post-firing coatings or surface treatments are applied by the manufacturer, the manufacturer shall report the type and extent of these coatings or surface treatments in all certificates of compliance with this specification.

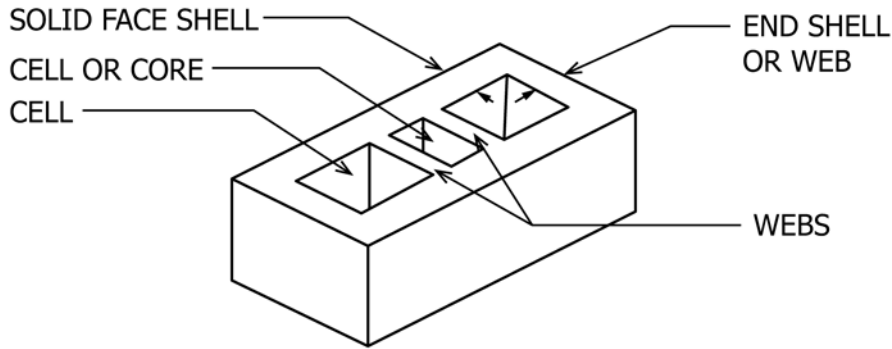
6. Physical Properties

6.1 *Durability*—When grade is not specified, the requirements for Grade SW shall govern.

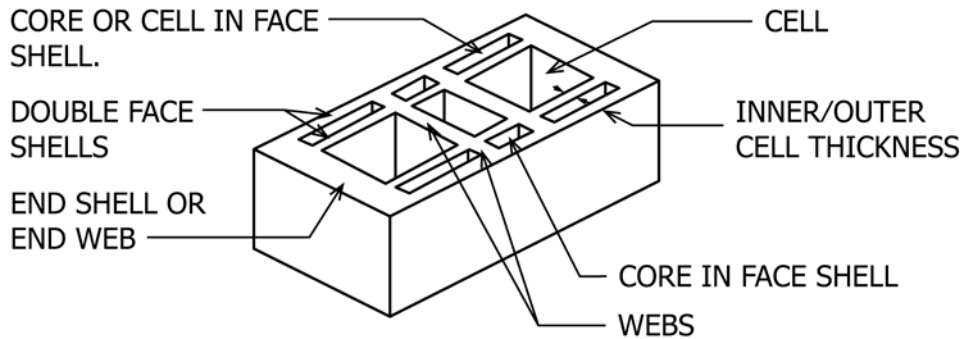
6.1.1 *Physical Property Requirements*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table 2. For the compressive strength requirements in Table 2, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

6.1.2 *Absorption Alternate*—The saturation coefficient requirement does not apply, provided that the 24-h cold water absorption of each of the five units tested does not exceed 8.0 %.

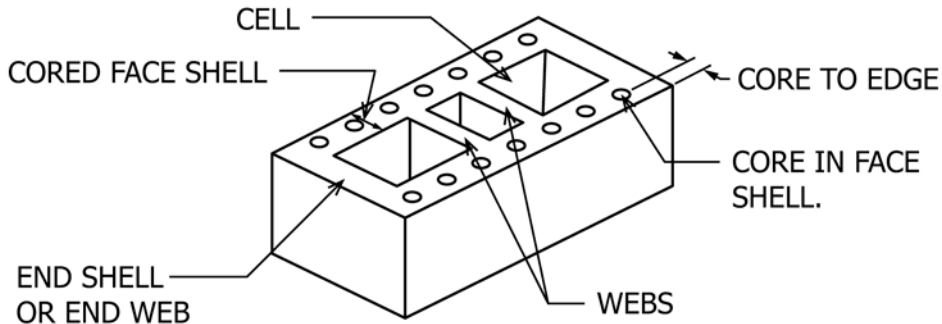
6.1.3 *Freezing and Thawing Alternative*—The requirements for 5-h boiling water absorption and saturation coefficient do not apply, provided a sample of five brick, meeting the strength



SOLID SHELL HOLLOW BRICK UNITS



DOUBLE SHELL HOLLOW BRICK UNITS



CORED SHELL HOLLOW BRICK UNITS

FOR MINIMUM DIMENSIONS SEE SECTION 10 AND TABLE 1

FIG. 1 Hollow Brick Units

TABLE 2 Physical Requirements

| Designation | Compressive Strength gross area, min, psi (MPa) | | Water Absorption by 5-h Boiling, max, % | | Saturation Coefficient, max | |
|-------------|---|-------------|---|------------|-----------------------------------|------------|
| | 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 |

requirements of Table 2, passes the freezing and thawing test as described in the Rating Section of the Freezing and Thawing test procedures of Test Methods C67.

NOTE 3—The 50-cycle freezing and thawing test is used as an alternative only when the brick do not conform to either Table 2 requirements for maximum water absorption and saturation coefficient, or

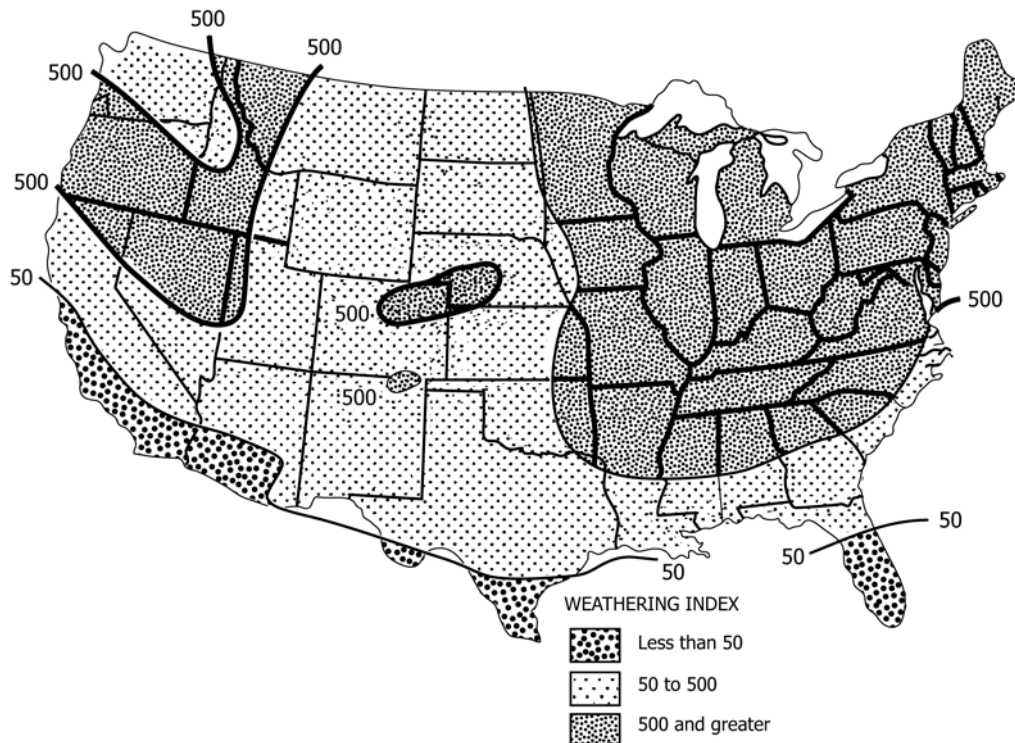
to the requirements of the Absorption Alternate in 6.1.2.

6.1.3.1 *Grade SW: Breakage and Weight Loss Requirement*—No individual unit separates or disintegrates resulting in a weight loss greater than 0.5 % of its original dry weight.

6.1.3.2 *Grade SW: Cracking Requirement*—No individual unit develops a crack that exceeds, in length, the unit's least dimension.

6.1.4 *Low Weathering Index Alternative:*

6.1.4.1 If the brick are intended for use exposed to weather where the weathering index is less than 50 (see Fig. 2), and unless otherwise specified, the requirements given in Table 2 for 5-h boiling water absorption and for saturation coefficient shall not apply, but the minimum average compressive strength requirement of 2500 psi (17.2 MPa) shall apply.



| Grade Recommendations for Face Exposures | | |
|--|---------------------------|----------------|
| Exposure | Weathering Index (Note 4) | |
| | Less than 50 | 50 and greater |
| In vertical surfaces: | | |
| In contact with earth | SW or MW | SW |
| Not in contact with earth | SW or MW | SW |
| In other than vertical surfaces: | | |
| In contact with earth | SW | SW |
| Not in contact with earth | SW or MW | SW |

FIG. 2 Weathering Indices in the United States

NOTE 4—The effect of weathering on brick is related to the weathering index, which for any locality is the product of the average annual number of *freezing cycle days* and the average annual *winter rainfall* in inches, as defined as follows.³

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 (0°C) or below, and the mean number of days during which the maximum temperature was 32°F (0°C) or below.

Winter Rainfall is the sum, in inches, 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. 2 indicates general areas of the United States that correspond to the weathering categories listed. The index for geographical locations near the 50 line 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 hollow brick, weathering index, and exposure is found in Fig. 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.

6.2 *Strength*—When hollow brick are required having strengths greater than prescribed in Table 2, the purchaser shall specify the desired minimum compressive strength.

6.3 *Initial Rate of Absorption (IRA)*—Test results for IRA shall be determined in accordance with the Initial Rate of Absorption (Suction) (Laboratory Test) section of Test Methods C67 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 5.

NOTE 5—*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 oven-dried procedure described in the IRA (Suction) (Laboratory Test) of Test Methods C67. IRA in the field depends on the moisture content of the

³ Data needed to determine the weathering for any locality may be found or estimated from tables of Local Climatological Data—Annual Summary with Comparative Data from the National Oceanic and Atmospheric Administration.

masonry unit and is determined in accordance with the IRA (Suction)—Field Test of Test Methods C67. Units having average field IRA exceeding 30 g/min per 30 in.² (30 g/min 194 cm²) should have their IRA reduced below 30 g/min per 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.

7. Efflorescence

7.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be “not effloresced.” If the rating for efflorescence is “effloresced,” the brick represented by the testing do not meet the efflorescence requirements of this specification.

8. Dimensions and Permissible Variations

8.1 *Size*—The size of hollow brick shall be as specified by the purchaser. In a sample of ten hollow brick selected to include the extreme range of color and sizes to be supplied, no hollow brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table 3. Tolerances on dimensions for Type HBA shall be as specified by the purchaser, but not more restrictive than HBS and HBB.

NOTE 6—Brick names denoting sizes may be regional and therefore may not be included in all reference books. Purchasers should ascertain the size of brick available in their locality and should specify accordingly, stating the desired dimensions (width by height by length).

8.2 *Warpage*—Tolerances for warpage of surfaces or edges intended to be exposed in use of individual hollow brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table 4. Tolerances on warpage for Type HBA shall be as specified by the purchaser.

9. Finish and Appearance

9.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits of Table 5. The limits apply to the types as specified. The aggregate length of chips shall not exceed 10 % of the perimeter of the exposed face or faces of the hollow brick.

9.2 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 under diffused lighting from a

TABLE 4 Tolerances on Warpage, in. (mm)

| Dimension, max | Permissible Warpage, max | |
|---------------------------|--------------------------|-------------|
| | Type HBX | Type HBS |
| 8 (204) and under | 1/16 (1.58) | 3/32 (2.38) |
| Over 8 to 12, (306), incl | 3/32 (2.38) | 1/8 (3.18) |
| Over 12 to 16 (408), incl | 1/8 (3.18) | 5/32 (3.97) |

distance of 15 ft (4.6 m) for Type HBX and a distance of 20 ft (6.1 m) for Types HBS and HBA.

NOTE 7—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 5, ranges up to 5 % for HBX, up to 10 % for HBS (formed), and up to 15 % for HBS (altered). 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 HBS (formed) units will conform to the requirements of Table 5 if not more than 10 % of the units have edge chips greater than 1/4 in. (6.4 mm) but less than 5/16 in. (7.9 mm), or corner chips greater than 3/8 in. (9.5 mm) but less than 1/2 in. (2.7 mm) and the remainder of the units, in this maximum case 90 % (100 % – 10 %), do not have edge chips greater than 1/4 in. (6.4 mm) in from the edge nor corner chips greater than 3/8 in. (9.5 mm) in from the corner.

NOTE 8—Brick may have rolled edges with varying dimensions. This can affect the appearance of the masonry when the mortar joint is tooled because the mortar joint thickness can vary when the brick edge is not straight.

9.3 The number of hollow brick in a delivery that are broken or otherwise fail to meet the requirements for chippage and tolerances shall not exceed 5 %.

9.4 After brick are placed in usage 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 tolerances.

9.5 If brick having a particular color, color range, or texture are desired, these features shall be specified separately by the purchaser. At least one end of the majority of the individual hollow 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 hollow brick, each representing the texture desired. The color range shall be indicated by the approved sample.

9.6 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 9—The manufacturer should be consulted for the availability of specialty units suitable for the intended purpose.

10. Coring and Frogging

10.1 *Cores*—The distance of any core (void space having a gross cross-sectional area equal to or less than 1 1/2 in.² (9.68 cm²)) from exposed edges shall be not less than 5/8 in. (16 mm), except for cored-shell hollow brick.

10.1.1 Cored-shell hollow brick shall have a minimum shell thickness of 1 1/2 in. Cores greater than 1 in.² (6.45 cm²) in cored shells shall be not less than 1/2 in. (13 mm) from any

TABLE 3 Tolerances on Dimensions, in. (mm)

| Specified Dimensions | Permissible Variation, max | |
|---------------------------|----------------------------|------------------|
| | Type HBX | Type HBS and HBB |
| 3 (76) and under | ±1/16 (1.58) | ±3/32 (2.38) |
| Over 3 to 4 (102), incl | ±3/32 (2.38) | ±1/8 (3.18) |
| Over 4 to 6 (152), incl | ±1/8 (3.18) | ±3/16 (4.76) |
| Over 6 to 8 (204), incl | ±3/32 (3.97) | ±1/4 (6.35) |
| Over 8 to 12 (306), incl | ±7/32 (5.56) | ±5/16 (7.94) |
| Over 12 to 16 (408), incl | ±3/16 (7.14) | ±3/8 (9.52) |

TABLE 5 Maximum Permissible Range of Chippage That Extends from the Edges and Corners of the 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 |
| HBX | 5 % or less | 1/8 to 1/4 (3.18 to 6.35) | 1/4 to 3/8 (6.35 to 9.52) | 95 to 100 % | 0 to 1/8 (0 to 3.18) | 0 to 1/4 (0 to 6.35) |
| HBS (formed) ^B | 10 % or less | 1/4 to 5/16 (6.35 to 7.94) | 3/8 to 1/2 (9.52 to 12.7) | 90 to 100 % | 0 to 1/4 (0 to 6.35) | 0 to 3/8 (0 to 9.52) |
| HBS (altered) ^C | 15 % or less | 5/16 to 7/16 (7.94 to 11.11) | 1/2 to 3/4 (12.7 to 19.05) | 85 to 100 % | 0 to 5/16 (0 to 7.94) | 0 to 1/2 (0 to 12.7) |
| HBA and HBB | to meet the designated sample or as specified by the purchaser, but not more restrictive than HBS (altered) | | | | | |

^AThe allowable percentage of brick that will be exposed in the wall having the allowed maximum size chips measured the listed maximum dimensions in from an edge or corner.

^BFormed units are extruded brick with an unbroken natural die finish face.

^CAltered units are extruded brick with the face sanded, combed, scratched, scarified, or broken by mechanical means such as wire-cutting or wire brushing, or are molded brick.

edge. Cores not greater than 1 in.² in shells cored not more than 35 %, shall be not less than 3/8 in. (10 mm) from any edge.

10.2 Cells—The distance of cells (void space having a gross cross-sectional area greater than 1 1/2 in.²) from any exposed edge of the unit shall not be less than 3/4 in. (19 mm), except for double-shell hollow brick.

10.2.1 Double-shell hollow brick with inner and outer shells not less than 1/2 in. (13 mm) are permitted to have cells not greater than 5/8 in. (16 mm) in width nor 5 in. (127 mm) in length between the inner and outer shell.

10.3 Webs—The thickness of webs between cells shall not be less than 1/2 in. (13 mm), 3/8 in. (9.5 mm) between cells and cores, or 1/4 in. (6 mm) between cores.

10.4 Unexposed Edges—The distance of voids to grooves recessed 1/2 in. (13 mm) or greater shall be a minimum of 1/2 in. (13 mm).

10.5 Frogging—Brick are frogged at the option of the manufacturer; brick required to be without frogs shall be specified by the purchaser and shall meet all other requirements of this section. One bearing surface of each brick shall be permitted to have a recess (panel frog), or deep frogs, or both. 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 5/8 in. (15.9 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 bearing surface shall conform to other requirements of this specification for coring, frogging, and void area.

11. Sampling and Testing

11.1 The brick shall be sampled and tested in accordance with applicable sections in Test Methods C67.

NOTE 10—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.

11.2 The manufacturer or the seller shall furnish specimens for test. The place or places of selection shall be designated when the purchase order is placed.

12. Keywords

12.1 appearance requirements; clay; fired masonry unit; hollow brick; hollow building brick; hollow facing brick; masonry; physical properties; shale

SUMMARY OF CHANGES

Committee C15 has identified the location of selected changes to this standard since the last issue (C652 – 15) that may impact the use of this standard. (March 15, 2017)

- (1) Modified 4.1 to add language on saturation.
- (2) Added new **Note 1**—Language on influencers of freeze thaw durability performance.

Committee C15 has identified the location of selected changes to this standard since the last issue (C652 – 14) that may impact the use of this standard. (August 1, 2015)

- (1) Face shell thicknesses in **Table 1** were reduced for units with 10 inch and greater nominal widths.

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