



Designation: **C652—17a C652 – 19**

# Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)<sup>1</sup>

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 ( $\epsilon$ ) 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.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

C34 Specification for Structural Clay Loadbearing 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

<sup>1</sup> 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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<sup>2</sup> 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

- 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 for 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 and thawing when saturated at a moisture content not exceeding the 24-h cold water absorption. Two grades of hollow brick are covered and the 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 (Severe Weathering)*—Hollow brick intended for use where high resistance to damage caused by cyclic freezing and thawing is desired.

4.1.2 *Grade MW (Moderate Weathering)*—Hollow brick intended for use where moderate resistance to cyclic freezing and thawing damage is permissible.

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).

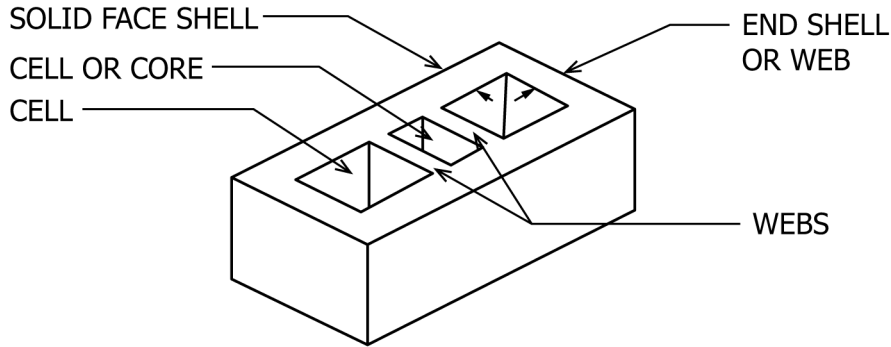
4.3.3 When the class is not specified, the requirements of Class H40V shall govern.

### 5. Materials and Manufacture

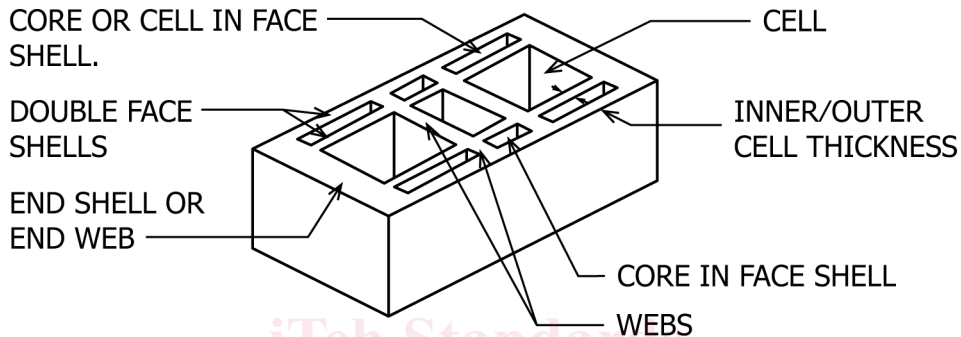
5.1 The body of all hollow brick shall be of clay, shale, fire clay, or mixtures of these materials, with or without admixtures, burned to meet the requirements of this specification. Any coloring or other materials added to the clay shall be suitable ceramic materials and shall be well distributed throughout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

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

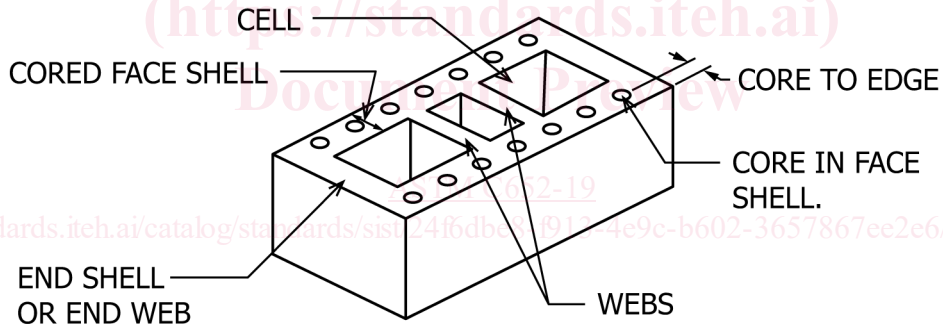
Nominal Width of Units	Face Shell Thicknesses		End Shells or End Webs
	Solid	Cored or Double Shell	
3 and 4 (76 and 101)	¾ (19.05)	...	¾ (19.05)
6 (152)	1 (25.4)	1½ (38)	1 (25.4)
8 (203)	1¼ (32)	1½ (38)	1 (25.4)
10 (254) and greater	1¼ (32)	1⅝ (41)	1 (25.4)



**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

5.2 Colors and textures produced by application of inorganic coatings to the façes-finished face(s) 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 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.

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.<sup>3</sup>

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 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.<sup>2</sup> (30 g/min 194 cm<sup>2</sup>) should have their IRA reduced below 30 g/min per 30 in.<sup>2</sup> 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.

**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
Grade MW	2500 (17.2)	2200 (15.2)	22.0	25.0	0.88	0.90

<sup>3</sup> 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.