



Designation: ~~C652—21~~ C652 – 22

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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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; intended for use in masonry and supplying structural and/or facing components to the structure. 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,~~ 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).

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 compliance with the requirements 7)~~ of this ~~standard~~ specification is beyond the ~~scope~~ intent of this ~~specification.~~ standard.

1.3 This specification does not cover brick intended for use as paving brick (see Specification C902).

1.4 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.)

1.4.1 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.

1.5 Four types of hollow brick in each of two grades and two classes are covered.

1.6 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 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.

Current edition approved June 1, 2021/June 1, 2022. Published June 2021/June 2022. Originally approved in 1970. Last previous edition approved in 2019/2021 as C652—19b-C652 – 21. DOI: 10.1520/C0652-21-10.1520/C0652-22.

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

1.7 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.

1.8 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.

1.9 *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:²

- C34 Specification for Structural Clay Loadbearing Wall Tile
- C62 Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
- C67/C67M 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 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 7.

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.

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.

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 11 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 11 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. Ordering Information

5.1 Orders for hollow brick under this specification shall include the following information:

5.1.1 *Grade (4.1)*—Grade SW governs when grade is not specified.

5.1.2 *Type (4.2)*—Type HBS governs when type is not specified.

5.1.3 *Class (4.3)*—Specify Class H40V or H60V. or accept Class H40V governs if Class is not specified.

5.1.4 *Size (9.1)*—Specify size of brick, width by height by length.

5.1.4.1 For Type HBA, specify tolerances on dimensions (9.1), warpage (9.2), or approve a designated sample.

5.1.5 Color, color range, and texture (10.5) by approving a sample.

5.1.5.1 For Type HBB, color, color range and texture are not required.

5.1.6 Finish on more than one face and one end (10.6).

5.1.7 *Sampling (12.2)*—Place(s) of selection for test specimens.

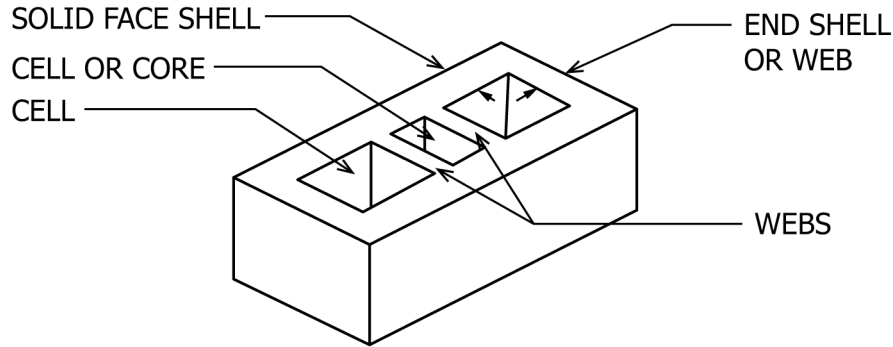
5.2 Orders for hollow brick under this specification may include the following information:

5.2.1 *Strength (7.2)*—Specify only if above minimum compressive strength in Table 2.

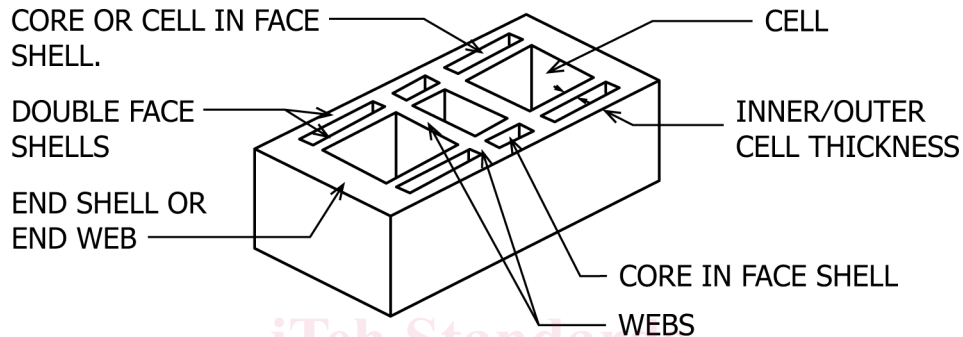
5.2.2 *Special Shapes (10.6)*—Specify size, dimensions and finished faces by approved shop drawing or other means.

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

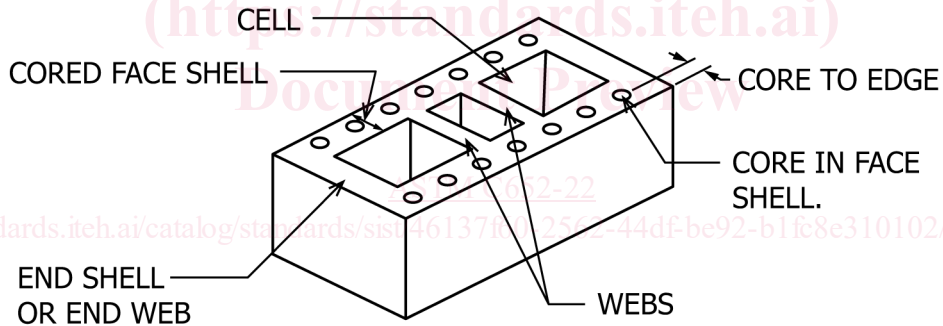
Nominal Width of Units	Face Shell Thicknesses		End Shells or End Webs
	Solid	Cored or Double Shell	
3 and 4 (76 and 101)	¾ (19.05)	...	¾ (19.05)
6 (152)	1 (25.4)	1½ (38)	1 (25.4)
8 (203)	1¼ (32)	1½ (38)	1 (25.4)
10 (254) and greater	1¼ (32)	1⅝ (41)	1 (25.4)



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

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

5.2.3 *Frogging (10.5)*—Frog permitted in one bearing surface if not specified.

5.2.4 *Costs of Tests (Note 11)*—Party who will pay and conditions of payment of compliance testing.

NOTE 2—See 6.3 and Section 7 for optional information.

6. Materials and Manufacture

6.1 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.

6.2 Colors and textures produced by application of inorganic coatings to the 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 3—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.

6.3 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.

6.4 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.

7. Physical Properties

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

7.1.1 *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.

7.1.2 *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 %.

7.1.3 *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/C67M**.

NOTE 4—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 **7.1.2**.

7.1.3.1 *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.

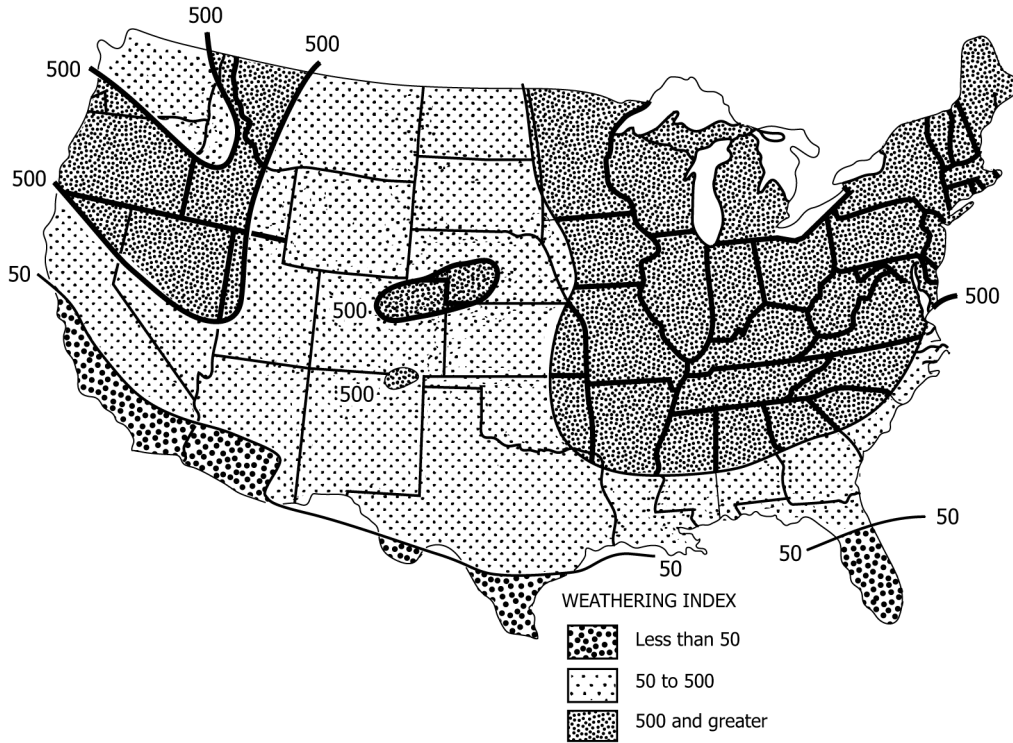
7.1.3.2 *Grade SW: Cracking Requirement*—No individual unit develops a crack that exceeds, in length, the unit's least dimension.

7.1.4 *Low Weathering Index Alternative:*

7.1.4.1 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 5—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

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.



Grade Recommendations for Face Exposures

Exposure	Weathering Index (Note 5)	
	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

<https://standards.iteh.ai/catalog/standards/sist/46137160-2562-44df-be92-b1fc8e310102/astm-c652-22>

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.

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

7.3 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/C67M 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 6.

NOTE 6—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/C67M. 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/C67M**. 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.

8. Efflorescence

8.1 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/C67M**, 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.

9. Dimensions and Permissible Variations

9.1 *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 7—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).

9.2 *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.

10. Finish and Appearance

10.1 Each finished face 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 on an individual finished face shall not exceed 10 % of the perimeter of that same finished face of the hollow brick.

10.2 Other than chips, each finished face that will be exposed in place shall be free of cracks or other imperfections detracting from the appearance of the designated sample when viewed from a position approximately perpendicular to the sample face under diffused lighting at a 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 8—Of all the units that will have a finished face exposed in place, a small percentage of the units may have chips on the finished face 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 have a finished face 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 ¼ in. (6.4 mm) but less than ⅝ in. (7.9 mm), or corner chips greater than ⅜ in. (9.5 mm) but less than ½ in. (2.7 mm) and the remainder of the units, in this maximum case 90 % (100 % – 10 %), do not have edge chips greater than ¼ in. (6.4 mm) in from the edge nor corner chips greater than ⅜ in. (9.5 mm) in from the corner.

NOTE 9—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.

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	±5/32 (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	±9/32 (7.14)	±3/8 (9.52)