



Designation: C 90 – 01a

Standard Specification for Loadbearing Concrete Masonry Units¹

This standard is issued under the fixed designation C 90; 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 hollow and solid (see 5.3 and 5.4) concrete masonry units made from portland cement, water, and mineral aggregates with or without the inclusion of other materials. There are three classes of concrete masonry units: (1) normal weight, (2) medium weight, and (3) lightweight. These units are suitable for both loadbearing and nonloadbearing applications.

1.2 Concrete masonry units covered by this specification are made from lightweight or normal weight aggregates, or both.

1.3 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.

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

NOTE 1—When particular features are desired such as surface textures for appearance or bond, finish, color, or particular properties such as weight classification, higher compressive strength, fire resistance, thermal performance or acoustical performance, these features should be specified separately by the purchaser. Local suppliers should be consulted as to the availability of units having the desired features.

2. Referenced Documents

2.1 ASTM Standards:

- C 33 Specification for Concrete Aggregates²
- C 140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units³
- C 150 Specification for Portland Cement⁴
- C 331 Specification for Lightweight Aggregates for Concrete Masonry Units²
- C 426 Test Method for Drying Shrinkage of Concrete Masonry Units³
- C 595 Specification for Blended Hydraulic Cements⁴
- C 618 Specification for Coal Fly Ash and Raw or Calcined

Natural Pozzolan for Use as a Mineral Admixture in Concrete²

C 989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars²

C 1157 Performance Specification for Hydraulic Cement⁴

C 1209 Terminology of Concrete Masonry Units and Related Units³

C 1232 Terminology of Masonry³

C 1314 Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry³

E 519 Test Method for Diagonal Tension (Shear) in Masonry Assemblages³

E 72 Methods for Conducting Strength Tests of Panels for Building Construction⁵

3. Terminology

3.1 Terminology defined in Terminology C 1209 and Terminology C 1232 shall apply for this specification.

4. Materials

4.1 *Cementitious Materials*—Materials shall conform to the following applicable specifications:

4.1.1 *Portland Cement*—Specification C 150.

4.1.2 *Modified Portland Cement*—Portland cement conforming to Specification C 150, modified as follows:

4.1.2.1 *Limestone*—Calcium carbonate, with a minimum 85 % CaCO₃ content, is permitted to be added to the cement, provided these requirements of Specification C 150 as modified are met:

(1) *Limitation on Insoluble Residue*—1.5 %.

(2) *Limitation on Air Content of Mortar*—Volume percent, 22 % max.

(3) *Limitation on Loss on Ignition*—7 %.

4.1.3 *Blended Hydraulic Cements*—Specification C 595.

4.1.4 *Hydraulic Cement*—Specification C 1157.

4.1.5 *Pozzolans*—Specification C 618.

4.1.6 *Blast Furnace Slag Cement*—Specification C 989.

4.2 *Aggregates*—Aggregates shall conform to the following specifications, except that grading requirements shall not necessarily apply:

4.2.1 *Normal Weight Aggregates*—Specification C 33.

¹ This specification is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.03 on Concrete Masonry Units and Related Units.

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² *Annual Book of ASTM Standards*, Vol 04.02.

³ *Annual Book of ASTM Standards*, Vol 04.05.

⁴ *Annual Book of ASTM Standards*, Vol 04.01.

⁵ *Annual Book of ASTM Standards*, Vol 04.07.

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

4.2.2 *Lightweight Aggregates*—Specification C 331.

4.3 *Other Constituents*—Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other constituents shall be previously established as suitable for use in concrete masonry units and shall conform to applicable ASTM standards or shall be shown by test or experience not to be detrimental to the durability of the concrete masonry units or any material customarily used in masonry construction.

5. Physical Requirements

5.1 At the time of delivery to the purchaser, units shall conform to the physical requirements prescribed in Table 1 and Table 2.

NOTE 2—Higher compressive strengths than those listed in Table 2 may be specified where required by design. Consult with local suppliers to determine availability of units of higher compressive strength.

5.2 At the time of delivery to the purchaser, the linear shrinkage of units shall not exceed 0.065 %.

NOTE 3—The purchaser is the public body or authority, association, corporation, partnership, or individual entering into a contract or agreement to purchase or install, or both, concrete masonry units. The time of delivery to the purchaser is FOB plant when the purchaser or the purchaser’s agent transports the concrete masonry units, or at the time unloaded at the worksite if the manufacturer or the manufacturer’s agent transports the concrete masonry units.

5.3 *Hollow Units*:

5.3.1 Face shell thickness (t_{fs}) and web thickness (t_w) shall conform to the requirements prescribed in Table 1.

NOTE 4—Web thickness (t_w) not conforming to the requirements prescribed in Table 1 may be approved, provided equivalent structural capability has been established when tested in accordance with the

applicable provisions of Test Methods E 72, C 1314, E 519, or other applicable tests and the appropriate design criteria developed in accordance with applicable building codes.

5.4 *Solid Units*:

5.4.1 The net cross-sectional area of solid units in every plane parallel to the bearing surface shall be not less than 75 % of the gross cross-sectional area measured in the same plane.

5.5 *End Flanges*:

5.5.1 For units having end flanges, the thickness of each flange shall not be less than the minimum face shell thickness.

NOTE 5—Flanges beveled at the ends for mortarless head joint applications that will be filled with grout are exempt from this requirement. Flanges which are specially shaped for mortarless head joint applications which have been shown by testing or field experience to provide equivalent performance are exempt from this requirement.

6. Permissible Variations in Dimensions

6.1 *Standard Units*—For standard units, no overall dimension (width, height, and length) shall differ by more than $\pm 1/8$ in. (3.2 mm) from the specified dimensions.

6.2 *Particular Feature Units*—For particular feature units, dimensions shall be in accordance with the following:

6.2.1 For molded face units, no overall dimension (width, height, and length) shall differ by more than $\pm 1/8$ in. (3.2 mm) from the specified standard dimension. Dimensions of molded features shall be within $\pm 1/16$ in. (1.6 mm) of the specified standard dimensions and shall be within $\pm 1/16$ in. (1.6 mm) of the specified placement of the molded feature.

NOTE 6—Molded features include, but are not limited to: ribs, scores, hex-shapes, and patterns.

6.2.2 For split-faced units, all non-split overall dimensions shall differ by not more than $\pm 1/8$ in. (3.2 mm) from the specified standard dimensions. On faces that are split, overall dimension will vary. Consult with local suppliers to determine achievable dimensional tolerances.

6.2.3 For slump units, no overall height dimension shall differ by more than $\pm 1/8$ in. (3.2 mm) from the specified standard dimension. On faces that are slumped, overall dimensions will vary. Consult with local suppliers to determine achievable dimensional tolerances.

7. Finish and Appearance

7.1 All units shall be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction. Minor cracks, incidental to the usual method of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery, are not grounds for rejection.

7.2 Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 20 ft (6.1 m) under diffused lighting.

7.2.1 Five percent of a shipment containing chips, not larger than 1 in. (25.4 mm) in any dimension, or cracks not wider than 0.02 in. (0.5 mm) and not longer than 25 % of the nominal height of the unit, is permitted.

7.3 The color and texture of units shall be specified by the

TABLE 1 Minimum Thickness of Face Shells and Webs

Nominal Width (W) of Units, in. (mm)	Face Shell Thickness (t_{fs}), min, in. (mm) ^A	Web Thickness (t_w)	
		Webs ^B min, in. (mm)	Equivalent Web Thickness, min, in./linear ft ^{B,C} (mm/linear m)
3 (76.2) and 4 (102)	3/4 (19)	3/4 (19)	1 5/8 (136)
6 (152)	1 (25) ^D	1 (25)	2 1/4 (188)
8 (203)	1 1/4 (32) ^D	1 (25)	2 1/4 (188)
10 (254)	1 3/8 (35) ^D	1 1/8 (29)	2 1/2 (209)
12 (305) and greater	1 1/4 (32) ^{D,E}	1 1/8 (29)	2 1/2 (209)
	1 1/2 (38)		
	1 1/4 (32) ^{D,E}		

^A Average of measurements on 3 units taken at the thinnest point when measured as described in Test Methods C 140. When this standard is used for split face units, a maximum of 10 % of a split face shell area is permitted to have thickness less than those shown, but not less than 3/4 in. (19.1 mm). When the units are solid grouted the 10 % limit does not apply.

^B Average of measurements on 3 units taken at the thinnest point when measured as described in Test Methods C 140. The minimum web thickness for units with webs closer than 1 in. (25.4 mm) apart shall be 3/4 in. (19.1 mm).

^C Sum of the measured thicknesses of all webs in the unit, multiplied by 12 and divided by the length of the unit. Equivalent web thickness does not apply to the portion of the unit to be filled with grout. The length of that portion shall be deducted from the overall length of the unit for the calculation of the equivalent web thickness.

^D For solid grouted masonry construction, minimum face shell thickness shall be not less than 5/8 in. (16 mm).

^E This face shell thickness (t_{fs}) is applicable where allowable design load is reduced in proportion to the reduction in thickness from basic face shell thicknesses shown, except that allowable design loads on solid grouted units shall not be reduced.