J.B. SPEED SCHOOL OF ENGINEERING

ASTM Masonry Specifications and Testing Standards – A Summary of Recent Changes and Updates

Oct 13, 2022

W. Mark McGinley, Ph. D., PE FASTM, FTMS

11:15 am to ????

Presentation Outline

This session will review changes in the Standards under the jurisdiction of ASTM C 12 Committee on Mortars and Grouts for Unit Masonry and C 15 On Manufactured Masonry Units. These committees maintain standards such as ASTM C 270 on mortars, C 90 on Concrete Masonry Units, C 216 on Clay Masonry Units, among many others. A summary of recent changes of select standards will be presented and discussed. Also discussed will be the planned merger ASTM C 12 and C 15 committees.

ASTM C 12 and C15, its sub committees, and task groups are constantly updating its Masonry Standards

- There are at least 2 subcommittee and 2 main committee ballots each year

Please use the right ASTM Standard There may be major changes !!!

ASTM C 90 Table 2 90-16a

- Compressive strength requirements are independent of unit density

Example: Lightweight units are required to meet the same compressive strength minimum requirements as Medium weight and Normal weight units

C90 – 16a

TABLE 2 Strength, Absorption, and Density Classification Requirements[A]

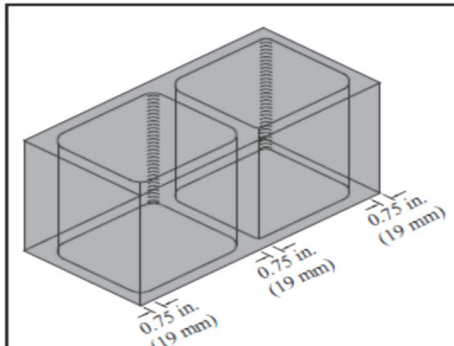
Density Classification	Oven-Dry Density of Concrete, lb/ft^3 (kg/m^3)	Maximum Water Absorption, lb/ft^3 (kg/m^3)		Minimum Net Area Compressive Strength, lb/in^2 (MPa)	
	Average of 3 Units	Average of 3 Units	Individual Units	Average of 3 Units	Individual Units
Lightweight	Less than 105 (1680)	18 (288)	20 (320)	2000 (13.8)	1800 (12.4)
Medium Weight	105 to less than 125 (1680–2000)	15 (240)	17 (272)	2000 (13.8)	1800 (12.4)
Normal Weight	125 (2000) or more	13 (208)	15 (240)	2000 (13.8)	1800 (12.4)

[A]Compressive strength, absorption, and density determined in accordance with 8.2.

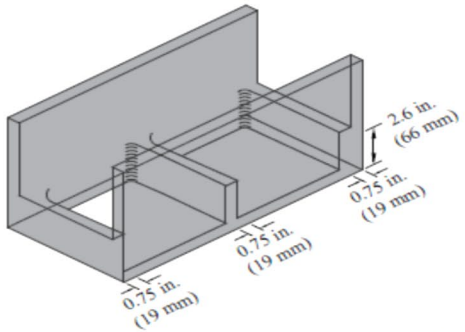
Use the right ASTM standard

Starting with C90-11b – Equivalent web area replaces equivalent web thickness

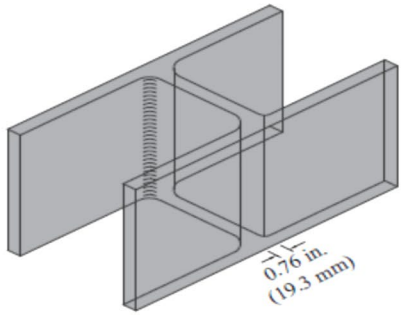
Examples of unit configurations that comply with new ASTM C90 web area requirements



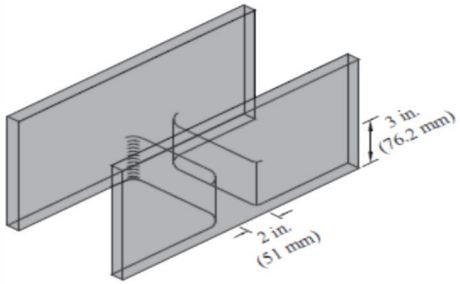
1a —Two-cell unit[B]



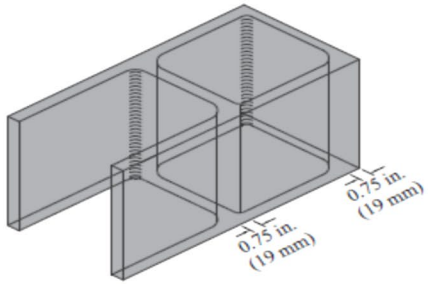
1b —Three reduced-height webs[B, C]



1c —Double open end or H block



1d —One reduced-height web[D]



1e —Open end or A block[B]

A Not all units are available in all areas. Consult local manufacturers.

B Note that 0.75 in. (19 mm) is the minimum web thickness. Thicker webs are permitted.

C 2.6 in. (66 mm) is the minimum web height that will meet the C90 normalized web area requirement for units with three 0.75 in. (19 mm) thick webs and nominal face dimensions of 8 in. x 16 in. (203 x 406 mm).

D The single web could be any combination of height and thickness that results in a web area of at least 6.5 in.^{2} of web/ft^2 of wall area (45,140 mm^2/m^2).

Figure 1—Examples of Web Configurations Permitted Under ASTM C90-11b[A]

ASTM C 12 Mortar and Grouts for Masonry Standards Other Recent Changes

Standard	Action	Title
C0476-22	09/01-2022	Specification for Grout for Masonry
C0780-20	06/15/2020	Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C0887-20	12/01/2020	Specification for:Packaged, Dry, Combined Materials for Surface Bonding Mortar
C1019-20	05/01/2019	Test Method for: Sampling and Testing Grout for Masonry
C1142	05/01/2019	Specification for:Extended Life Mortar for Unit Masonry
C1148	08/01/2022	Test Method for: Measuring the Drying Shrinkage of Masonry Mortar
C1180-22	12/01/2020	Terminology of: Mortar and Grout for Unit Masonry
C1324-20A	08/01/2022	Test Method for: Examination and Analysis of Hardened Masonry Mortar
C1403-22	07/01/2020	Test Method for: Rate of Water Absorption of Masonry Mortars
C1586-20	05/01/2019	Guide for: Quality Assurance of Mortars
C1714_C1714M-19A	05/01/2019	Standard Specification for Preblended Dry Mortar Mix for Unit Masonry

Changes in C 270 – Mortar Spec

C1329 Specification for Mortar Cement
C1384 Specification for Admixtures for Masonry Mortars
C1489 Specification for Lime Putty for Structural Purposes
C1506 Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters
C1586 Guide for Quality Assurance of Mortars
E72 Test Methods of Conducting Strength Tests of Panels for Building Construction
E514 Test Method for Water Penetration and Leakage Through Masonry
E518 Test Methods for Flexural Bond Strength of Masonry
2.2 *Masonry Industry Council:*[3]
Hot and Cold Weather Masonry Construction Manual, January 1999

3. Specification Limitations

3.1 Laboratory testing of mortar to ensure compliance with the property specification requirements of this specification shall be performed in accordance with 5.3. The property specification of this standard applies to mortar mixed to a specific flow in the laboratory.

3.2 Property specifications requirements in Table 1 shall not be used to evaluate construction site-produced mortars.

NOTE 2—Refer to X1.5.3.1 for further explanation.

3.3 Since the compressive strength values resulting from field tested mortars do not represent the compressive strength of mortar as tested in the laboratory nor that of the mortar in the wall, physical properties of field sampled mortar shall not be used to determine compliance to this specification and are not intended as criteria to determine the acceptance or rejection of the mortar (see Section 8 and Guide C1586).

4. Materials

4.1 Materials used as ingredients in the mortar shall conform to the requirements specified in 4.1.1 to 4.1.4.

4.1.1 *Cementitious Materials*—Cementitious materials shall conform to the following ASTM specifications:

4.1.1.1 *Portland Cement*—Types I, IA, II, IIA, III, IIIA, or V of Specification C150.

4.1.1.2 *Blended Hydraulic Cements*—Types IS(<70), IS(<70)-A, IP, IP-A of Specification C595.

4.1.1.3 *Hydraulic Cements*—Types GU, HE, MS, and HS of Specification C1157 (Types MH and LH are limited to use in the property specifications only).

4.1.1.4 *Portland Blast-Furnace Slag Cement (for Use in Property Specifications Only)*—Types IS(≥70) or IS(≥70)-A of Specification C595.

4.1.1.5 *Masonry Cement*—See Specification C91.

4.1.1.6 *Mortar Cement*—See Specification C1329.

4.1.1.7 *Quicklime*—See Specification C5.

4.1.1.8 *Hydrated Lime*—Specification C207, Types S or SA. Types N or NA limes are permitted if shown by test or performance record to be not detrimental to the soundness of the mortar.

4.1.1.9 *Lime Putty*—See Specification C1489.

4.1.2 *Aggregates*—See Specification C144.

4.1.3 *Water*—Water shall be clean and free of amounts of oils, acids, alkalies, salts, organic materials, or other substances that are deleterious to mortar or any metal in the wall.

4.1.4 *Admixtures*—Admixtures shall not be added to mortar unless specified. Admixtures shall not add more than 65 ppm (0.0065 %) water soluble chloride or 90 ppm (0.0090 %) acid soluble chloride to the mortar's overall chloride content, unless explicitly provided for in the contract documents.

4.1.4.1 *Classified Admixtures*—Admixtures which are classified as bond enhancers, workability enhancers, set accelerators, set retarders, and water repellents shall be in accordance with Specification C1384.

4.1.4.2 *Color Pigments*—Coloring pigments shall be in accordance with Specification C979.

4.1.4.3 *Unclassified Admixtures*—Mortars containing admixtures outside the scopes of Specifications C1384 and C979 shall be in accordance with the property requirements of this

[3] Available from the Mason Contractors Association of America, 1910 South Highland Avenue, Suite 101, Lombard, IL 60148.

TABLE 1 Property Specification Requirements[A]

Mortar	Type	Average Compressive Strength at 28 days, min, psi (MPa)	Water Retention, min, %	Air Content, max, %[B]	Aggregate Ratio (Measured in Damp, Loose Conditions)
Cement-Lime	M	2500 (17.2)	75	12	
	S	1800 (12.4)	75	12	
	N	750 (5.2)	75	14[C]	
	O	350 (2.4)	75	14[C]	
Mortar Cement	M	2500 (17.2)	75	12	Not less than 2 ¼ and not more than 3 ½ times the sum of the separate volumes of cementitious materials
	S	1800 (12.4)	75	12	
	N	750 (5.2)	75	14[C]	
	O	350 (2.4)	75	14[C]	
Masonry Cement	M	2500 (17.2)	75	18	
	S	1800 (12.4)	75	18	
	N	750 (5.2)	75	20[D]	
	O	350 (2.4)	75	20[D]	

[A] Laboratory prepared mortar only (see Note 5).
[B] See Note 6.
[C] When structural reinforcement is incorporated in cement-lime or mortar cement mortar, the maximum air content shall be 12 %.
[D] When structural reinforcement is incorporated in masonry cement mortar, the maximum air content shall be 18 %.

Units (Withdrawn 2017)[3]
C979/C979M Specification for Pigments for Integrally Colored Concrete
C1072 Test Methods for Measurement of Masonry Flexural Bond Strength
C1093 Practice for Accreditation of Testing Agencies for Masonry
C1157/C1157M Performance Specification for Hydraulic Cement
C1180 Terminology of Mortar and Grout for Unit Masonry
C1232 Terminology for Masonry
C1324 Test Method for Examination and Analysis of Hardened Masonry Mortar
C1329/C1329M Specification for Mortar Cement
C1384 Specification for Admixtures for Masonry Mortars
C1489 Specification for Lime Putty for Structural Purposes
C1506 Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters
C1586 Guide for Quality Assurance of Mortars
C1717 Test Methods for Conducting Strength Tests of Masonry Wall Panels
E514/E514M Test Method for Water Penetration and Leakage Through Masonry
E518/E518M Test Methods for Flexural Bond Strength of Masonry
2.2 *Masonry Industry Council:*[4]
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NOTE 2—Refer to X1.5.3.1 for further explanation.

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4.1.1.2 *Blended Hydraulic Cements*—Types IL, IL-A, IS, IS-A, IP, IP-A, IT, and IT-A of Specification C595/C595M. Blended hydraulic cements with 70 % or more slag cement content are only permitted for use in property specifications.

4.1.1.3 *Hydraulic Cements*—Types GU, HE, MS, and HS of Specification C1157/C1157M. Types MH and LH are only permitted for use in property specifications.

4.1.1.4 *Masonry Cement*—See Specification C91/C91M.

4.1.1.5 *Mortar Cement*—See Specification C1329/C1329M.

4.1.1.6 *Quicklime*—See Specification C5.

4.1.1.7 *Hydrated Lime*—Specification C207, Types S or SA. Types N or NA limes are permitted if shown by test or performance record to be not detrimental to the soundness of the mortar.

4.1.1.8 *Lime Putty*—See Specification C1489.

4.1.2 *Aggregates*—See Specification C144.

[3] The last approved version of this historical standard is referenced on ww.astm.org.
[4] Available from the Mason Contractors Association of America, 1910 South ighland Avenue, Suite 101, Lombard, IL 60148.

TABLE 1 Property Specification Requirements[A]

Mortar	Type	Average Compressive Strength at 28 days, min, psi (MPa)	Water Retention, min, %	Air Content, max, %[B]	Aggregate Ratio (Measured in Damp, Loose Conditions)
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Changes in C 270 – Mortar Spec

C 270 -14a – Table

TABLE 1 Property Specification Requirements[A]

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	S	1800 (12.4)	75	18	
	N	750 (5.2)	75	20[D]	
	O	350 (2.4)	75	20[D]	

[A]Laboratory prepared mortar only (see Note 5).
[B]See Note 6.
[C]When structural reinforcement is incorporated in cement-lime or mortar cement mortar, the maximum air content shall be 12 %.
[D]When structural reinforcement is incorporated in masonry cement mortar, the maximum air content shall be 18 %.

C 270 -19a – Table

Testing of bond in Mortar Cement allowed relaxation of air limits

TABLE 1 Property Specification Requirements[A]

Mortar	Type	Average Compressive Strength at 28 days, min, psi (MPa)	Water Retention, min, %	Air Content, max, %[B]	Aggregate Ratio (Measured in Damp, Loose Conditions)
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	O	350 (2.4)	75	20[D]	

[A]Laboratory prepared mortar only (see Note 5).
[B]See Note 6.
[C]When structural reinforcement is incorporated in cement-lime, the maximum air content shall be 12 %.
[D]When structural reinforcement is incorporated in masonry cement mortar or mortar cement mortar, the maximum air content shall be 18 %.

Changes in C 270 – Mortar Spec

C 270 -14a – Materials

4.1.1 *Cementitious Materials*—Cementitious materials shall conform to the following ASTM specifications:

4.1.1.1 *Portland Cement*—Types I, IA, II, IIA, III, IIIA, or V of Specification C150.

4.1.1.2 *Blended Hydraulic Cements*—Types IS(<70), IS(<70)-A, IP, IP-A of Specification C595.

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4.1.1.6 *Mortar Cement*—See Specification C1329.

4.1.1.7 *Quicklime*—See Specification C5.

4.1.1.8 *Hydrated Lime*—Specification C207, Types S or SA. Types N or NA limes are permitted if shown by test or performance record to be not detrimental to the soundness of the mortar.

4.1.1.9 *Lime Putty*—See Specification C1489.

4.1.2 *Aggregates*—See Specification C144.

C 270 -19a – Materials

4.1 Materials used as ingredients in the mortar shall conform to the requirements specified in 4.1.1 to 4.1.4.

4.1.1 *Cementitious Materials*—Cementitious materials shall conform to the following ASTM specifications:

4.1.1.1 *Portland Cement*—Types I, IA, II, IIA, III, IIIA, or V of Specification C150/C150M.

4.1.1.2 *Blended Hydraulic Cements*—Types IL, IL-A, IS, IS-A, IP, IP-A, IT, and IT-A of Specification C595/C595M. Blended hydraulic cements with 70 % or more slag cement content are only permitted for use in property specifications.

4.1.1.3 *Hydraulic Cements*—Types GU, HE, MS, and HS of Specification C1157/C1157M. Types MH and LH are only permitted for use in property specifications.

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4.1.1.7 *Hydrated Lime*—Specification C207, Types S or SA. Types N or NA limes are permitted if shown by test or performance record to be not detrimental to the soundness of the mortar.

4.1.1.8 *Lime Putty*—See Specification C1489.

Testing from Canada allowed much greater use of Blended Cement types in mortar

Changes in C 476 – Grout Spec

C 476 -19– 4. Grout Type and …

4.2.1 *Conventional Grout*—Proportions shall be determined by one of the following methods:

4.2.1.1 Requirements of Table 1.

4.2.1.2 *Specified Compressive Strength*—Proportions established by 28-day compressive strength tests in accordance with Test Method C1019 that equal or exceed the specified compressive strength. The grout shall be mixed to a slump of 8 to 11 in. (200 to 280 mm) as determined by Test Method C143/C143M and shall have a minimum compressive strength of 2000 psi (14 MPa) at 28 days.

4.2.2 *Self-consolidating Grout*—Proportions shall be determined by the following method:

4.2.2.1 *Specified Compressive Strength*—Proportions established by 28-day compressive strength tests in accordance with Test Method C1019 that equal or exceed the specified compressive strength. The grout shall be mixed to a slump flow of 24 to 30 in. (610 to 760 mm) as determined by Test Method C1611/C1611M and shall have a Visual Stability Index (VSI) of not greater than 1 as determined by Appendix X1 of Test Method C1611/C1611M. The grout shall have a minimum compressive strength of 2000 psi (14 MPa) at 28 days.

C 476 -22 – 4. Grout Type and …

4.2 *Proportions of Ingredients*—Proportions shall be determined as follows:

4.2.1 *Conventional Grout*—The grout shall be mixed to a slump of 8 to 11 in. (200 to 280 mm) as determined by Test Method C143/C143M. Proportions shall be determined by one of the following methods:

4.2.1.1 Requirements of Table 1.

4.2.1.2 *Specified Compressive Strength*—Proportions established by 28-day compressive strength tests in accordance with Test Method C1019 that equal or exceed the specified compressive strength. The grout shall have a minimum compressive strength of 2000 psi (14 MPa) at 28 days.

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Clarified that Table 1 applies to Conventional grout and your can meet proportions of compressive strength - also earlier changes allow most types of cement to be used and blended with fly ash etc.

Changes in C 780 Test Method for Preconstruction and Construction Evaluation of Mortars….

C 780 -18a– 9 Sampling….

9.3.1 Take batch mixer samples immediately after mixing, either during the discharge of the mixer or after the mortar has been discharged into the mortar receptacle. If samples are taken during the discharge of the mixer, they shall be taken at any time except for the first and last 10 % of the batch. Samples of the mortar taken after discharge from the mixer shall be representative of the entire batch.

9.3.2 Take mortar for mortar board tests in accordance with 9.3.1, and place upon mortar boards typical of those used or to be used at the project. For construction site testing, expose the test mortar on the board(s) to climatic conditions typical of those on the jobsite. When mortar from a mason's mortar board is used for test purposes, identify it further to reflect this exception for proper data interpretation. Thoroughly hand-mix mortar selected for testing with a trowel immediately before sampling for tests or specimens. Record the lapsed time from the end of mixing as part of the test data.

9.3.3 Take retempered mortar board samples from the mason's mortar board at recorded time periods after mixing and retempering. Thoroughly hand-mix all mortar on the board with a trowel before sampling.

C 780 -20 – 4. Grout Type and …

9.3.1 Take as-mixed samples as follows: When mixing is performed in a mixer, obtain samples either during the discharge of the mixer or after the mortar has been discharged into the mortar receptacle. If samples are taken during the discharge of the mixer, they shall be taken at any time except for the first and last 10 % of the batch. Samples of the mortar taken after discharge from the mixer shall be representative of the entire batch. When mixing is not performed in a mixer, obtain samples following the procedure in 9.3.

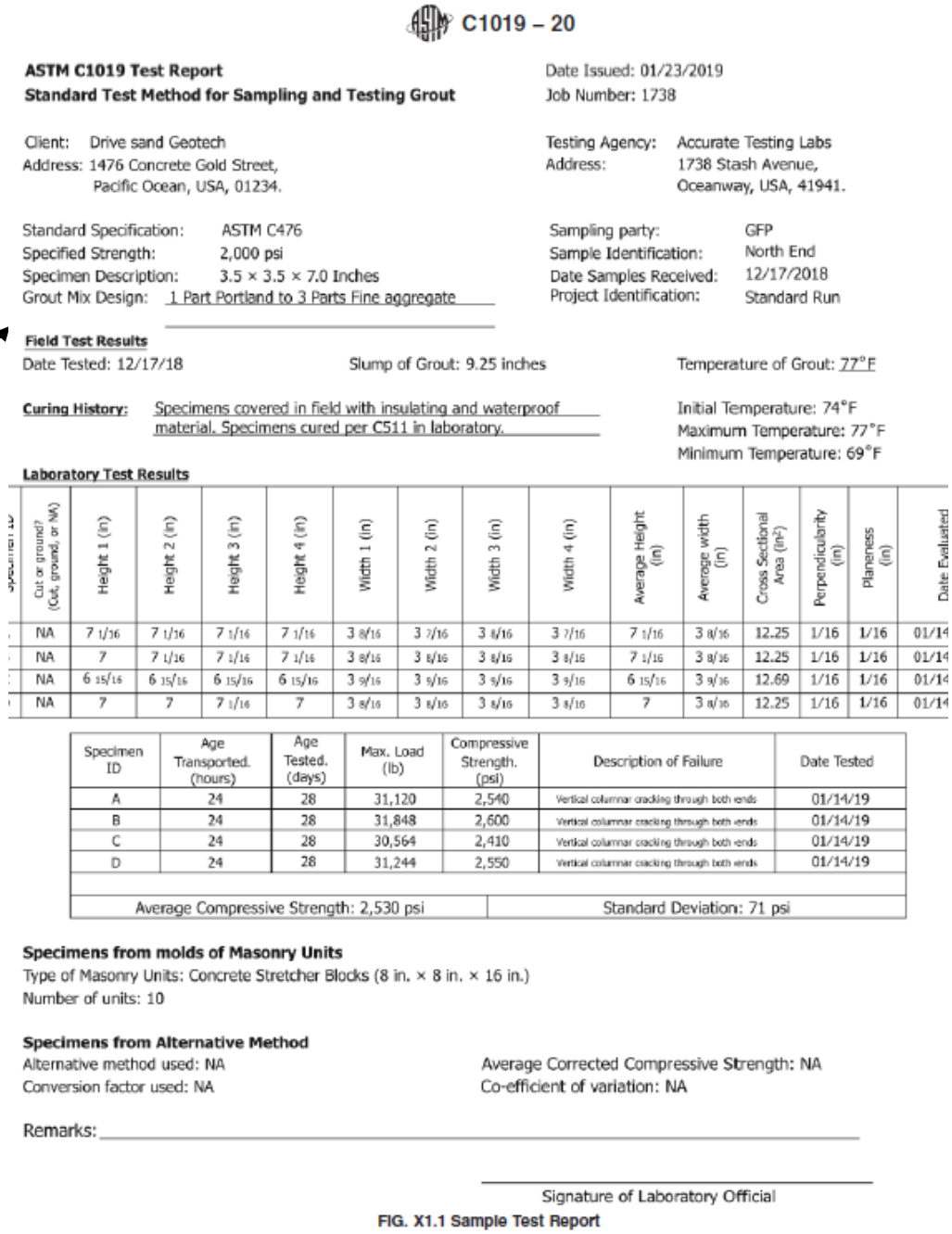
9.3.2 Take mortar for mortar board tests in accordance with 9.3.1, and place upon mortar boards typical of those used or to be used at the project. For construction site testing, expose the test mortar on the board(s) to climatic conditions typical of those on the jobsite. When mortar from a mason's mortar board is used for test purposes, identify it further to reflect this exception for proper data interpretation. Thoroughly hand-mix mortar selected for testing with a trowel immediately before sampling for tests or specimens. Record the lapsed time from the end of mixing as part of the test data.

9.3.3 Take retempered mortar board samples from the mason's mortar board at recorded time periods after mixing and retempering. Thoroughly hand-mix all mortar on the board with a trowel before sampling.

Clarified that we are sampling "as mixed samples"

Changes in C 1019 –Sampling and Testing Grout…

Sample Test report Added



C1019 – 20

ASTM C1019 Test Report
Standard Test Method for Sampling and Testing Grout

Date Issued: 01/23/2019
Job Number: 1738

Client: Drive sand Geotech
Address: 1476 Concrete Gold Street, Pacific Ocean, USA, 01234.

Testing Agency: Accurate Testing Labs
Address: 1738 Stash Avenue, Oceanway, USA, 41941.

Standard Specification: ASTM C476
Specified Strength: 2,000 psi
Specimen Description: 3.5 × 3.5 × 7.0 Inches
Grout Mix Design: 1 Part Portland to 3 Parts Fine aggregate

Sampling party: GFP
Sample Identification: North End
Date Samples Received: 12/17/2018
Project Identification: Standard Run

Field Test Results
Date Tested: 12/17/18
Slump of Grout: 9.25 inches
Temperature of Grout: 77°F

Curing History: Specimens covered in field with insulating and waterproof material. Specimens cured per C511 in laboratory.

Initial Temperature: 74°F
Maximum Temperature: 77°F
Minimum Temperature: 69°F

Laboratory Test Results

Specimen ID	Cut or ground? (Cut, ground, or NA)	Height 1 (in)	Height 2 (in)	Height 3 (in)	Height 4 (in)	Width 1 (in)	Width 2 (in)	Width 3 (in)	Width 4 (in)	Average Height (in)	Average width (in)	Cross Sectional Area (in²)	Perpendicularity (in)	Planeness (in)	Date Evaluated
	NA	7 1/16	7 1/16	7 1/16	7 1/16	3 8/16	3 7/16	3 8/16	3 7/16	7 1/16	3 8/16	12.25	1/16	1/16	01/14
	NA	7	7 1/16	7 1/16	7 1/16	3 8/16	3 8/16	3 8/16	3 8/16	7 1/16	3 8/16	12.25	1/16	1/16	01/14
	NA	6 15/16	6 15/16	6 15/16	6 15/16	3 9/16	3 9/16	3 9/16	3 9/16	6 15/16	3 9/16	12.69	1/16	1/16	01/14
	NA	7	7	7 1/16	7	3 8/16	3 8/16	3 8/16	3 8/16	7	3 8/16	12.25	1/16	1/16	01/14

Specimen ID	Age Transported. (hours)	Age Tested. (days)	Max. Load (lb)	Compressive Strength. (psi)	Description of Failure	Date Tested
A	24	28	31,120	2,540	Vertical columnar cracking through both ends	01/14/19
B	24	28	31,848	2,600	Vertical columnar cracking through both ends	01/14/19
C	24	28	30,564	2,410	Vertical columnar cracking through both ends	01/14/19
D	24	28	31,244	2,550	Vertical columnar cracking through both ends	01/14/19
Average Compressive Strength: 2,530 psi				Standard Deviation: 71 psi		

Specimens from molds of Masonry Units
Type of Masonry Units: Concrete Stretcher Blocks (8 in. × 8 in. × 16 in.)
Number of units: 10

Specimens from Alternative Method
Alternative method used: NA
Conversion factor used: NA
Average Corrected Compressive Strength: NA
Co-efficient of variation: NA

Remarks:

Signature of Laboratory Official

FIG. X1.1 Sample Test Report

ASTM C 15 Masonry Units and Assemblies

Too many ballot items in the last two years to show

Changes in C 140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

New Annex Added for Testing Concrete Ballast Block

A9. TEST PROCEDURES FOR CONCRETE BALLAST BLOCK

A9.1 Scope

A9.1.1 This annex includes testing requirements that are particular for concrete ballast block that are manufactured for compliance with the following unit specifications: C1884.

A9.2 Sampling

A9.2.1 A set shall consist of a minimum of six full-size units, unless freeze-thaw durability testing is required. When freeze-thaw durability testing is required, a set shall consist of a minimum of eight full-size units.

A9.3 Measurement

A9.3.1 For each of three units, measure and record the following to the nearest division required to be reported:

A9.3.1.1 Width (W) at mid-length across the top and bottom bearing surfaces. Average the two recorded values to determine the width of the specimen.

A9.3.1.2 Height (H) at mid-length on each face. Average the two recorded values to determine the height of the specimen.

A9.3.1.3 Length (L) at mid-height on each face. Average the two recorded values to determine the length of the specimen.

A9.4 Compressive Strength Testing

A9.4.1 *Number of Specimens*—When freeze-thaw durability testing is required, test five units for compressive strength. Otherwise test three units for compressive strength.

A9.4.2 *Test Specimens*—Specimens shall be saw-cut coupons. The compressive strength of the coupon shall be considered to be the compressive strength of the whole unit. Saw-cutting shall be performed in accordance with 7.2.4. The coupon size shall conform with the following:

(1) Targeted coupon width shall be as close to 2 in. [50 mm] as possible, but in no case less than 1.5 in. [40 mm].

(2) Targeted aspect ratio (height divided by width, H_s/W_s) of 2.0 before capping.

(3) Targeted length to width ratio (L_s/W_s) of 4.0.

(4) Actual coupon dimensions shall not differ by more than 0.12 in. [3 mm] from targeted dimensions.

(5) Coupons shall be solid and not contain voids.

A9.4.2.1 Measure coupons in accordance with A9.4.3.

A9.4.3 *Coupon Measurement*—Coupon measurements shall be performed to the nearest 0.01 in. [0.25 mm] using a measurement device readable and accurate to 0.01 in. [0.25 mm]. Measurements shall be taken as follows:

A9.4.3.1 *Width*—Measure and record the width of the coupon (W_s) across the top and bottom surfaces at mid-length. Average the two recorded values to determine the width of the coupon.

A9.4.3.2 *Height*—Measure and record the height of the coupon (H_s) at mid-length on each face. Average the two recorded values to determine the height of the coupon.

A9.4.3.3 *Length*—Measure and record the length of the coupon (L_s) at mid-height of each face. Average the two recorded values to determine the length of the coupon.

NOTE A9.1—The compressive strength of coupons saw-cut from concrete ballast block can be measurably influenced by the unit configuration and location of the sample. Due to the variety of unit configurations available, it is not possible to specify exact locations for obtaining coupons. In order to compare results within a set or between independently performed tests, coupons should be consistently obtained from the same location for a given unit configuration. Suppliers should be consulted for the recommended coupon sample location for a given unit configuration.

A9.4.4 *Testing*—Cap and test specimens in accordance with 7.3 and 7.4.

A9.5 Absorption Testing

A9.5.1 *Apparatus*—Absorption testing apparatus shall comply with 8.1.

A9.5.2 *Test Specimens:*

A9.5.2.1 Test three specimens for absorption.

A9.5.2.2 Specimens shall be full-sized specimens.

A9.5.3 *Testing*—Perform absorption tests in accordance with 8.3.

A9.6 Calculations

A9.6.1 Calculate absorption, density, net area, and net area compressive strength in accordance with Section 9.

A9.7 Report

A9.7.1 Test reports shall include all of the information in Section 10 and the following (see Note A9.2):

NOTE A9.2—For concrete ballast block, a set consists of either six specimens (when only compressive strength and absorption is tested) or eight specimens (when freeze-thaw durability is also tested). For calculation and reporting purposes, all specimens tested are to be included in both individual and average test results.

A9.7.1.1 The average width, height and length to the nearest 0.1 in. [2.5 mm] separately for each specimen and as the average for the specimens tested.

A9.7.1.2 The net area to the nearest 0.1 in.^{2} [50 mm^2] separately for each specimen and as the average for the specimens tested.

A9.7.1.3 The maximum load separately for each specimen and as the average for the specimens tested. Record the load as indicated to the nearest 10 lb [50 N] or the minimum resolution of the test machine as used during testing, whichever is greater.

A9.7.1.4 The net area compressive strength to the nearest 10 psi [0.1 MPa] separately for each specimen and as the average for the specimens tested.

A9.7.1.5 The immersed, saturated, and oven dry weights (w_i, w_s, and w_d) to the nearest 0.1 lb [0.05 kg] separately for each specimen and as the average for the specimens tested (see Note A9.3).

NOTE A9.3—Oven-dry weight is an important property for concrete ballast block which requires the average to meet or exceed the specified minimum weight, with no individual unit less than 90 % of the specified minimum weight. Therefore, this property should be included in any Summary of Test Results section of the report as required in 10.4.

Changes in C 140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

Added 2021 Guidance for calculating Net area

Most of this section has been revised

A1.6 Calculations

A1.6.1 Calculate absorption, moisture content, density, average net area, and net area compressive strength in accordance with Section 9.

A1.6.2 *Minimum Web Area*—Calculate the minimum web area using A1.6.2.1 or A1.6.2.2 (see Appendix X3):

A1.6.2.1 For rectangular webs, calculate the web area for each web (or portion thereof) that has measured web dimensions (height and thickness) greater than 0.75 in. [19 mm] as follows:

$$A_{wx}, \text{in.}^2[\text{mm}^2] = t_{wx} \times t_{hx} \quad \text{(A1.1)}$$

where:

A_{wx} = minimum area of web 'x', in.^{2} [mm^2],
t_{wx} = minimum thickness of web 'x', in. [mm], and
t_{hx} = minimum height of web 'x', in. [mm].

A1.6.2.2 For non-rectangular webs, see A1.3.5.2 to determine minimum web area.

A1.6.3 *Total Minimum Web Area*—Calculate the total minimum web area (A_{wt}) as follows:

$$A_{wt}, \text{in.}^2[\text{mm}^2] = A_{w1} + A_{w2} + A_{w3} + \ldots + A_{wy} \quad \text{(A1.2)}$$

where:

A_{wt} = total minimum web area, in.^{2} [mm^2],
A_{w1} = minimum web area of web 1, in.^{2} [mm^2],
A_{w2} = minimum web area of web 2, in.^{2} [mm^2],
A_{w3} = minimum web area of web 3, in.^{2} [mm^2], and
A_{wy} = minimum web area of web 'y', in.^{2} [mm^2].

NOTE A1.5—The total minimum web area is determined by adding the individual web areas for each web of the unit that has measured web dimensions (height and thickness) greater than 0.75 in. [19 mm]. See also Note A1.7.

A1.6.4 *Normalized Web Area*—Calculate the normalized web area (A_{wn}) of each unit by dividing the total minimum web area (A_{wt}) by the nominal length and height of the unit as follows (see Note A1.7 and Appendix X3):

$$A_{wn}(\text{in.}^2/\text{ft}^2) = \frac{A_{wt}}{(L_n \times H_n)} \times 144 \quad \text{(A1.3)}$$

$$\left[A_{wn}\ (\text{mm}^2/\text{m}^2) = \frac{A_{wt}}{(L_n \times H_n)} \times 10^6\right]$$

where:

A_{wn} = normalized web area, in.^{2}/ft^2 [mm^2/m^2],
A_{wt} = total minimum web area, in.^{2} [mm^2] (see A1.3.5 and A1.6.3),
L_n = nominal length of unit, in. [mm], and
H_n = nominal height of unit, in. [mm].

NOTE A1.6—Minimum web area does not apply to the portion of the unit to be filled with grout. The portion of the unit to be filled with grout should be deducted from the calculation of the normalized web area.

NOTE A1.7—There are two common calculation errors that have been observed in determining normalized web area. The first is in determining total minimum web area (A_{wt}). This value should be calculated by determining the web area of each individual web (by multiplying the minimum web thickness for each web by the web height for rectangular webs) and then summing the values for all webs of the unit that exceed 0.75 in. [19 mm].

The second error arises from using the incorrect value for nominal length and nominal height. As defined in Terminology C1232, a nominal dimension is the 'dimension that is greater than the specified dimension by the thickness of a mortar joint. It is usually expressed as a whole number.' It is important to note that when calculating normalized web area, the values for length and height are the nominal dimensions of the unit, not the actual measured length and height.

To illustrate this, consider a concrete masonry unit with specified dimensions of 7.625 in. [190 mm] in width, 7.625 in. [190 mm] in height, and 15.625 in. [390 mm] in length. These specified dimensions are what actual dimensions are compared to for compliance with dimensional tolerances, and are typically similar to those actual measured dimensions. The unit has nominal dimensions of 8 in. [200 mm] in width, 8 in. [200 mm] in height, and 16 in. [400 mm] in length because a typical masonry mortar joint is 0.375 in. [10 mm]; these nominal dimensions should be used when calculating normalized web area.

A1.6.5 *Equivalent Thickness*—Equivalent thickness for concrete masonry is defined as the average thickness of solid material in the unit and is calculated as follows:

$$T_e, \text{in.} = (V_n / (L \times H)) \times 1728 \quad \text{(A1.4)}$$

$$[T_e, \ \text{mm} = (V_n / (L \times H))]$$

where:

T_e = equivalent thickness, in. [mm],
V_n = average net volume of full-size units, ft^3 [mm^3] (see 9.4),
L = average length of full-size units, in. [mm] (see A1.3.1), and
H = average height of full-size units, in. [mm] (see A1.3.1).

A1.6.5.1 Equivalent thickness shall only be calculated and reported for full-size concrete masonry units.

A1.6.6 *Percent Solid*—Calculate the percent solid in accordance with either A1.6.6.1 or A1.6.6.2:

A1.6.6.1 Except for irregularly shaped specimens, such as those with split surfaces, the percent solid of coupons and those specimens whose net cross-sectional area in every plane parallel to the bearing surface is equal to the gross cross-sectional area measured in the same plane is defined as 100.0 %.

A1.6.6.2 Calculate percent solid for all other specimens, including hollow units as follows:

Inch-pound units:

$$\text{Percent solid, } (\%) = \left(\frac{(V_n \times 1728)}{(L \times W \times H)}\right) \times 100 \quad \text{(A1.5)}$$

SI units:

$$\left[\text{Percent solid, } (\%) = \left(\frac{V_n \times 1000}{(L \times W \times H)}\right) \times 100\right] \quad \text{(A1.6)}$$

where:

V_n = net volume of specimen, ft^3 [cm^3] (see 9.4),
L = average length of specimen, in. [mm] (see A1.3.1),
W = average width of specimen, in. [mm] (see A1.3.1), and
H = average height of specimen, in. [mm] (see A1.3.1).

NOTE A1.8—This calculation determines the percentage of concrete in the gross volume of the unit. It is a useful reference value, but it is not a requirement of unit specifications. This value is not comparable to the definition of a solid unit in C90 and C129, which refers to the net cross-sectional area of every plane parallel to the bearing surface relative to the gross cross-sectional area of the same plane.

A1.6.7 *Maximum Variation from Specified Dimensions:*

Changes in C 140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

Added 2020 new guidance to reduce potential for common errors in calculations

NOTE A1.7—There are two common calculation errors that have been observed in determining normalized web area. The first is in determining total minimum web area (A_{wt}). This value should be calculated by determining the web area of each individual web (by multiplying the minimum web thickness for each web by the web height for rectangular webs) and then summing the values for all webs of the unit that exceed 0.75 in. [19 mm].

The second error arises from using the incorrect value for nominal length and nominal height. As defined in Terminology C1232, a nominal dimension is the 'dimension that is greater than the specified dimension by the thickness of a mortar joint. It is usually expressed as a whole number.' It is important to note that when calculating normalized web area, the values for length and height are the nominal dimensions of the unit, not the actual measured length and height.

To illustrate this, consider a concrete masonry unit with specified dimensions of 7.625 in. [190 mm] in width, 7.625 in. [190 mm] in height, and 15.625 in. [390 mm] in length. These specified dimensions are what actual dimensions are compared to for compliance with dimensional tolerances, and are typically similar to those actual measured dimensions. The unit has nominal dimensions of 8 in. [200 mm] in width, 8 in. [200 mm] in height, and 16 in. [400 mm] in length because a typical masonry mortar joint is 0.375 in. [10 mm]; these nominal dimensions should be used when calculating normalized web area.

C 1877 New Standard Specification for Adhered Concrete Masonry Units

Designation: C1877 – 19

Standard Specification for Adhered Concrete Masonry Units[1]

This standard is issued under the fixed designation C1877; 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.

1. Scope*

1.1 This specification covers solid, dry-cast, concrete masonry units intended for use as an interior and exterior adhered veneer and are made from portland cement, water, and suitable mineral aggregates with or without the inclusion of other materials.

1.2 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 standard.

1.3 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.

NOTE 1—Adhered concrete masonry units covered by this specification are made from lightweight or normal weight aggregates, or both.

NOTE 2—When particular features are desired, such as density classification, surface textures for appearance or bond, finish, color, fire resistance, insulation, acoustical properties, or other special features, such properties should be specified separately by the purchaser. Suppliers should be consulted as to the availability of adhered concrete masonry units having the desired features.

1.4 *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]

C33/C33M Specification for Concrete Aggregates

C140/C140M Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C150/C150M Specification for Portland Cement

C331/C331M Specification for Lightweight Aggregates for Concrete Masonry Units

C426 Test Method for Linear Drying Shrinkage of Concrete Masonry Units

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C979/C979M Specification for Pigments for Integrally Colored Concrete

C989/C989M Specification for Slag Cement for Use in Concrete and Mortars

C1157/C1157M Performance Specification for Hydraulic Cement

C1232 Terminology for Masonry

C1240 Specification for Silica Fume Used in Cementitious Mixtures

C1670/C1670M Specification for Adhered Manufactured Stone Masonry Veneer Units

3. Terminology

3.1 Terminology defined in Terminology C1232 shall apply for this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *adhered concrete masonry unit, n*—a nonloadbearing concrete masonry unit designed to be installed with a cementitious mortar to a backing surface.

4. Materials and Manufacture

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

4.1.1 *Portland Cement*—Specification C150/C150M.

4.1.2 *Modified Portland Cement*—Portland cement conforming to Specification C150/C150M, modified as follows:

4.1.2.1 *Limestone*—Calcium carbonate, with a minimum 85 % $CaCO_3$ content, is permitted to be added to the cement, provided these requirements of Specification C150/C150M 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 C595/C595M.

[1] This test method 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.

Current edition approved Dec. 1, 2019. Published December 2019. Originally approved in 2018. Last previous edition approved in 2018 as C1877 – 18. DOI: 10.1520/C1877-19

[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.

C 1884 New Standard Specification for Concrete Ballast Block

Designation: C1884 – 19

Standard Specification for Concrete Ballast Block[1]

This standard is issued under the fixed designation C1884; 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.

1. Scope*

1.1 This specification covers dry-cast concrete ballast blocks that are primarily used for ballast of rooftop equipment. These units are machine-made from hydraulic cement, water, and suitable mineral aggregates with or without the inclusion of other materials.

NOTE 1—The design of concrete ballast block systems for resisting wind uplift is beyond the scope of this specification. Building codes and other standards should be consulted in designing for wind uplift resistance.

1.2 The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.3 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.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:*

C33/C33M Specification for Concrete Aggregates

C331/C331M Specification for Lightweight Aggregates for Concrete Masonry Units

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C979/C979M Specification for Pigments for Integrally Colored Concrete

C989/C989M Specification for Slag Cement for Use in Concrete and Mortars

C1157/C1157M Performance Specification for Hydraulic Cement

C1232 Terminology for Masonry

C1240 Specification for Silica Fume Used in Cementitious Mixtures

C1262/C1262M Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units

3. Terminology

3.1 Terminology defined in Terminology C1232 shall apply to this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *concrete ballast block, n*—a manufactured concrete unit used primarily to provide weight for stabilizing rooftop equipment.

3.2.1.1 *Discussion*—An example application for concrete ballast block is ballast for photovoltaic arrays.

4. Material

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

4.1.1 *Portland Cement*—Specification C150/C150M.

4.1.2 *Modified Portland Cement*—Portland cement conforming to Specification C150/C150M, modified as follows:

C 1314-22 Standard Test Method for Compressive Strength of Masonry Prisms

C 1314-20

TABLE 1 Height to Thickness Correction Factors for Masonry Prism Compressive Strength

h_p/t_p[A]	1.3	1.5	2.0	2.5	3.0	4.0	5.0
Correction Factor	0.75	0.86	1.0	1.04	1.07	1.15	1.22

[A] h_p/t_p—Ratio of prism height to least lateral dimension of prism.

C 1314-22 Now goes to h/t = 1.0 Based on recent testing

C1314 – 22

TABLE 1 Height to Thickness Correction Factors for Masonry Prism Compressive Strength

h_p/t_p[A]	1.0	1.25	1.5	1.75	2.0	2.5	3.0	4.0	5.0
Correction Factor	0.83	0.93	0.96	0.98	1.0	1.04	1.07	1.15	1.22

[A] h_p/t_p—Ratio of prism height to least lateral dimension of prism.

Changes to C 426 Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units

2021 changes were made throughout to relax measurement time frames to make it easier on labs -weekends.

Changes to C 1093 Standard Practice for Accreditation of Testing Agencies for Masonry

2019 added requirements that technicians be certified

Changes to C 1670 Standard Specification for Adhered Manufactured Stone Masonry Veneer Units

2021 provisions added to allow either sampling at production location for mixes or to send raw materials for lab mixing

Changes to **ASTM C67/C67M** Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2021

2019 (Subsection 9.4.2) – Modified to indicate proper procedure for identifying cracks that extend in the freeze-thaw test.
2020 (Subsection 11.4.3) – Added alternate drying method for efflorescence test.
2021 (Subsection 7.3.4.2) – Added alternative speed of testing as a rate limit at which load is applied to specimen to determine compressive strength.

Changes to **ASTM C216** Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2022

2019 (Subsection 10.1.1) – Added that designated sample should be viewed "from a position approximately perpendicular to the sample face."
2021 (Various sections) – Where appropriate, changed the term "face" to "finished face" throughout the standard.
2022 (Subsection 10.3 & Deletion of NOTE immediately following) – Moved text in NOTE into standard (and deleted NOTE) that indicated that once brick are placed in the wall, the manufacturer or manufacturer's agent are not responsible for chippage and tolerances. This occurred after an official ASTM opinion determined that the language was not contractual.

Similar changes were Made to C 652 Hollow Units

Changes to **ASTM 1088** Standard Specification for Thin Veneer Brick Units Made From Clay or Shale 2020

Thin brick are now allowed to be as thick as 2 5/8” to conform to ASTM C1088. While the standard allows this thickness a note mentions that building codes such as IBC or TMS 402/602 may limit thickness to less than 2 5/8”, in many cases 1 ½”.

2018 (Section 5) – Added new Section on ordering information.
2018 (Section 11) – Added new Section on back surface texture.
2020 (Subsection 5.3) – Added new Subsection on post-firing coatings.

New Ballot to merge C 12 and C15

Discussions on merging ASTM committees C12 and C15 have occurred for many years. A few years ago, both committees were surveyed via ballot and the vast majority of these members of both committees supported the merger. However, this effort was put on hold due to other priorities.

We are moving this ahead because :

- It streamlines the administrative and leadership overhead of the two committees,
- There already are several joint subcommittees between C12 and C15,
- Masonry is an assembly of units, mortar and grout and are judged together by users and the construction industry in general,
- There is significant overlap in membership of both committees, and
- C12 has relatively fewer standards under their jurisdiction and combining standards into one committee will create efficiencies for standard development/revision.

New Ballot to merge C 12 and C15

Possible Structure of combined C12 and C15

- C15.02 on Brick and Structural Clay Tile
- C15.03 on Concrete Masonry Units
- C15.04 on Research
- C15.05 on Masonry Assemblies
- C15.06 on Roof Tile
- C15.10 on Autoclaved Aerated Concrete Units
- C15.12 on Alternative Masonry Materials and Related Units
- C15.20 on Research for Mortars and Grouts (formerly C12.02)
- ○ Standards: C780, C1019, C1324, C1403
- C15.30 on Specifications for Mortars and Grouts (consolidation of C12.03, C12.04, C12.05, and C12.06)
- ○ Standards: C144, C270, C404, C476, C887, C1384, C1586, C1660, C1713, C1714
- ○ Note that C12.06 currently has jurisdiction of C946, *Practice for Construction of Dry- Stacked, Surface-Bonded Walls*. It is proposed that this standard be transferred to C15.05 on Masonry Assemblies.

New Ballot to merge C 12 and C15

Possible Structure of combined C12 and C15

- C15.08 on Terminology (already joint with C12.08)
- ○ Standards: C1180, C1232
- C15.90 Executive Subcommittee (encompass C12.90)
- ○ Note that based on the merger, a completely new roster for the Executive
- Subcommittee will be elected by the members.
- C15.91 Editorial (to be combined with C12.91)
- C15.92 Symposia (already joint with C12.92)
- C15.96 Awards (to be combined C12.96)
- C15.98 Strategic Planning (already joint with C12.98)

J.B. SPEED SCHOOL
OF ENGINEERING

THANK YOU !

QUESTIONS?

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