



Designation: **C1670/C1670M – 13a** C1670/C1670M – 14

Standard Specification for Adhered Manufactured Stone Masonry Veneer Units¹

This standard is issued under the fixed designation C1670/C1670M; 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.

INTRODUCTION

The purpose of this standard is to establish the minimum product specifications for adhered manufactured stone masonry veneer units. These units are manufactured using a wet cast concrete mixture and finished to simulate stone, rocks found in nature, and other textures.

1. Scope-~~Scope~~*

1.1 This specification covers the minimum product requirements for adhered manufactured stone masonry veneer units applied as an adhered veneer to exterior and interior walls and structures suitable to receive units.

1.2 The property requirements of this specification apply at the time of delivery. This standard does not address the physical evaluation of installed units removed from service.

1.3 The units described by this specification are manufactured from a mixture of cement, normal or lightweight aggregates (or a combination of both), water, admixtures, other cementitious materials and other components which are wet-cast into shapes simulating the appearance of natural stone and other textures.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes shall not be considered as requirements of the standard.

1.6 *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 and health practices and determine the applicability of regulatory limitations prior to use of units.*

NOTE 1—When particular features are desired such as surface textures or color these features should be specified separately. Suppliers should be consulted as to the availability of units having the desired features.

2. Referenced Documents

2.1 *ASTM Standards:*

[C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field](#)

[C33 Specification for Concrete Aggregates](#)

[C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens](#)

[C140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units](#)

[C150 Specification for Portland Cement](#)

~~[C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory](#)~~

[C207 Specification for Hydrated Lime for Masonry Purposes](#)

[C260 Specification for Air-Entraining Admixtures for Concrete](#)

[C330 Specification for Lightweight Aggregates for Structural Concrete](#)

[C331 Specification for Lightweight Aggregates for Concrete Masonry Units](#)

[C426 Test Method for Linear Drying Shrinkage of Concrete Masonry Units](#)

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. 15, 2013 Aug. 1, 2014. Published January 2014 September 2014. Originally approved in 2013. Last previous edition approved in 2013 as C1670/C1670M – 13a. – 13. DOI: [10.1520/C1670-13A](#); [10.1520/C1670_C1670M-14](#).

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

[C482 Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste](#)
[C494/C494M Specification for Chemical Admixtures for Concrete](#)
[C595 Specification for Blended Hydraulic Cements](#)
[C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete](#)
[C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing](#)
[C979 Specification for Pigments for Integrally Colored Concrete](#)
[C989 Specification for Slag Cement for Use in Concrete and Mortars](#)
[C1116/C1116M Specification for Fiber-Reinforced Concrete](#)
[C1157 Performance Specification for Hydraulic Cement](#)
[C1232 Terminology of Masonry](#)
[C1240 Specification for Silica Fume Used in Cementitious Mixtures](#)

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 manufactured stone masonry veneer unit, n*—a non-load bearing masonry unit that is produced by wet-cast blending of cementitious material, lightweight and other aggregates, pigments and admixtures, designed to be applied with a cementitious mortar to a backing surface.

3.2.2 *unit profile, n*—the combination of units that represent the range of shapes and sizes provided in the specified veneer.

3.2.3 *average thickness, n*—the mean of the depth measurement of the unit as measured from the back side to the face side.

3.2.4 *designated area, n*—the area of a completed wall section that is used to verify compliance.

3.2.5 *saturated density, n*—the water saturated weight of the cured specimen divided by the volume of the specimen.

3.2.6 *wet cast, adj*—manufactured from a measurable slump concrete.

4. Materials

4.1 Cementitious materials shall conform to the following applicable specifications:

4.1.1 *Portland Cement*—Specification [C150](#).

4.1.2 *Blended Hydraulic Cements*—Specification [C595](#).

4.1.3 *Pozzolans*—Specification [C618](#).

4.1.4 *Slag Cement*—Specification [C989](#).

4.1.5 *Hydraulic Cement*—Specification [C1157](#).

4.1.6 *Silica Fume*—Specification [C1240](#).

4.1.7 *Hydrated Lime*—Specification [C207](#).

4.2 *Aggregates*—Aggregates shall conform to the following specifications:

4.2.1 *Normal Weight Aggregates*—Specification [C33](#).

4.2.2 *Lightweight Aggregates*—Specification [C330](#) or [C331](#).

4.3 *Air-Entraining Admixtures*—Specification [C260](#).

4.4 *Concrete Admixtures*—Specification [C494/C494M](#).

4.5 *Coloring Pigments*—Specification [C979](#).

4.6 *Reinforcement Fibers*—Specification [C1116/C1116M](#).

4.7 *Other Constituents:*

4.7.1 Other constituent materials shall be shown by test of experience or history of performance under equivalent conditions not to be detrimental to the durability of the adhered manufactured stone masonry veneer unit, or adhered manufactured stone masonry veneer construction, or both.

5. Sampling

5.1 *Concrete Mix for Units*—From each manufacturing location, obtain representative samples from standard production of each concrete mix used for units in accordance with [5.2](#).

5.1.1 Sample and test the concrete mixes used for units no more than twelve months prior to production of units. More frequent testing shall be required if there is any change in the manufacturing process including changes in cementitious materials or their sources, aggregates or their sources, volume of water mix design, manufacturing process or curing. This does not include producing units of varying shapes, configurations or sizes of units.

5.2 Sample the concrete mix at the manufacturing facility from standard production mix in accordance with Practice [C31/C31M](#); with the following exceptions:

5.2.1 For compressive strength testing prepare five 4 in. diameter by 8 in. [100 mm by 200 mm] cylinders in accordance with Practice ~~C192/C192M~~ and test in accordance with 6.1. Do not disturb the curing cylinders for a minimum of 48 hours after casting. De-mold them at an age of seven days.

5.2.2 For freeze/thaw durability testing, prepare five 3 in. by 3 in. by 11 in. [75 mm by 75 mm by 275 mm] beams in accordance with Section 7 of Practice ~~C192/C192M~~.

5.2.2.1 The molded beams shall be de-molded 24-32 hours after casting.

5.2.2.2 The molded beams shall be air-cured for 28 days.

5.3 ~~Units~~—From each manufacturing location, obtain a minimum of eight (8) samples totaling at least 5 ft² [0.5 m²] of units that are representative of the unit profile from which they are selected, using the same cementitious materials, aggregates, mix design, manufacturing process and curing.

5.3.1 Sampling and testing should be performed at least annually to meet the requirements of this standard.

5. Compressive Strength

5.1 From each manufacturing location, obtain representative samples from standard production of each concrete mix used for units in accordance with 5.2.

5.1.1 Sample and test the concrete mixes used for units no more than twelve months prior to production of units. More frequent testing shall be required if there is any change in the manufacturing process including changes in cementitious materials or their sources, aggregates or their sources, water-cementitious materials ratio, mix design, manufacturing process or curing. This does not include producing units of varying shapes, configurations or sizes of units.

5.2 Sample the concrete mix at the manufacturing facility from standard production mix. Form compressive strength and absorption specimens in accordance with Practice ~~C31/C31M~~; except that the time requirements for transportation do not apply when specimens are shipped to the testing laboratory.

5.2.1 For compressive strength testing, prepare five 4-in. diameter by 8 in. [100 mm by 200 mm] cylinders and test in accordance with 5.3. Do not disturb the curing cylinders for a minimum of 48 hours after casting. De-mold them at an age of seven days.

5.3 Test specimens at an age of 28 days in accordance with Test Method ~~C39/C39M~~.

5.4 The average compressive strength of five specimens shall be a minimum of 2100 psi [15 MPa] with no individual specimen having a measured compressive strength less than 1800 psi [12 MPa].

6. Physical Properties and Testing Requirements of Unit Concrete Mix Freeze-Thaw Durability

6.1 ~~Compressive Strength~~—From each manufacturing location, obtain representative samples from standard production of each concrete mix used for units in accordance with 6.2.

6.1.1 ~~Test specimens at an age of 28 days in accordance with Test Method~~ Sample and test the concrete mixes used for units no more than twelve months prior to production of units. More frequent testing shall be required if there is any change in the manufacturing process including ~~C39/C39M~~ changes in cementitious materials or their sources, aggregates or their sources, water-cementitious materials ratio, mix design, manufacturing process or curing. This does not include producing units of varying shapes, configurations or sizes of units.

6.1.1.1 The average compressive strength of five specimens shall be a minimum of 2100 psi [15 MPa] with no individual specimen having a measured compressive strength less than 1800 psi [12 MPa].

6.2 Sample the concrete mix at the manufacturing facility from standard production mix in accordance with Practice ~~C31/C31M~~ except that the time requirements for transportation do not apply when specimens are shipped to the testing laboratory.

6.2.1 For freeze/thaw durability testing, prepare five 3 in. by 3 in. by 11 in. [75 mm by 75 mm by 275 mm] beams. The molded beams shall be de-molded 24-32 hours after casting and shall be air cured for 28 days.

6.3 ~~Resistance to Freezing and Thawing: Testing Requirements:~~

6.3.1 No single specimen in a group of five specimens shall exhibit a mass loss greater than 1.5 % or show any fracture completely through the cross section when tested in accordance with Test Method ~~C666/C666M~~, Procedure A, with the following modifications:

6.3.1.1 The molded beams are subjected to 50 consecutive cycles of freezing and thawing.

6.3.2 Determine mass loss in accordance with the following procedure:

6.3.2.1 Following immersion in water for a period of 48 hours, the initial specimen mass shall be measured. Excess surface water shall be immediately removed by blotting with damp cloth or fabric towel prior to mass measurement;

6.3.2.2 Following the completion of 50 freeze thaw cycles in accordance with Test Method ~~C666/C666M~~—~~Procedure~~, Procedure A, the specimens shall be removed from the containers and excess surface water shall be removed by blotting with damp cloth or fabric towel;

6.3.2.3 The Percent Mass Loss (PWL) for each specimen shall be determined at 50 cycles and be calculated as follows:

$$\text{PWL (beam), \%} = [(M_0 - M_1)/M_0] \times 100$$

where:

where:

- PWL (beam) = percent mass loss of beam
 M_0 = initial mass of beam following 48-hour saturation
 M_1 = final mass of beam following 50 freeze/thaw cycles

6.3.2.4 Any test specimen which fractures completely through the cross section into two or more discrete sections shall be recorded as a failure.

6.3.3 In the case of specimen failure under [6.2.2.46.3.2.4](#), the failure mode must be reported in detail.

NOTE 2—Freeze-thaw testing is conducted on prism samples cast from representative concrete mix designs. While each manufacturer takes precautions to ensure that the surface color is durable, this freeze-thaw testing does not include a colored prism sample.

NOTE 1—Freeze-thaw testing is conducted on prism samples cast from representative concrete mix designs. While each manufacturer takes precautions to ensure that the surface color is durable, this freeze-thaw testing does not include a colored prism sample.

7. Physical Properties and Testing Requirements of Units **Shear Bond**

7.1 **Dimensions:** From each manufacturing location, obtain a minimum of five (5) samples of units that are representative of the unit profile from which they are selected, using the same cementitious materials, aggregates, mix design, manufacturing process and curing.

7.1.1 Units shall have a minimum thickness of ¼ in. [6 mm] except those parts of a unit within 0.5 in. [13 mm] of the unit perimeter.

7.1.2 The average thickness² of each unit shall be less than or equal to 2 5/8 in. [67 mm].

7.1.1 Units shall not exceed 36 in. [915 mm] in any face dimension and shall not exceed more than 5 ft. Sampling and testing should be performed at least annually² [0.5 m to meet²] in total face area; the requirements of this standard.

7.2 **Shear Bond Strength:** Each unit tested shall develop a shear bond strength with the mortar substrate of not less than 50 psi [350 kPa] when tested in accordance with Test Method [C482](#) with the following modifications (listed in [7.2.1](#) through [7.2.5](#)):

7.2.1 Test a minimum of five (5) units at a minimum age of 28 days after manufacture.

NOTE 3—Test Method [C482](#) requires curing for seven (7) days following fabrication of test specimens. It is acceptable to begin fabrication of shear bond specimens 21 days following manufacture of the units.

7.2.2 Use the mortar substrate for non-vitreous tile (water absorption greater than 7 %).

7.2.3 Each unit tested shall develop a shear bond strength with the mortar substrate of not less than 50 psi [350 kPa] when tested in accordance with Test Method [C482](#) with no greater than 2 5/8 in. [67 mm] and maximum dimensions of 4 in. by 4 in. [100 mm by 100 mm], with a thickness no greater than 2 5/8 in. [67 mm]. This sample is to be cut containing the back pattern of the [7.2.1.1](#) throughout [7.2.1.5](#); the entire back face.

7.2.1.1 Test a minimum of five (5) units at a minimum age of 28 days after manufacture.

7.2.1.2 Use the mortar substrate for non-vitreous tile (water absorption greater than 7 %).

7.2.1.3 Use a unit that can be cut into a sample with minimum dimensions of 2 ¼ in. by 2 ¼ in. [60 mm by 60 mm] and maximum dimensions of 4 in. by 4 in. [100 mm by 100 mm], with a thickness no greater than 2 5/8 in. [67 mm]. This sample is to be cut containing the back pattern of the unit throughout the entire back face.

7.2.1.4 Use a ½ in. [13 mm] by ½ in. [13 mm] steel bar (in place of the key) whose length shall be sufficient to reach the outer edges of the sample unit across its length. The steel bar shall be placed adjacent and parallel to the sample mortar interface.

7.2.1.5 Evaluate shear bond results of actual bonding surface of unit as manufactured. If the back surface of the unit used for testing has a directional back pattern, this back pattern shall be parallel to the direction of loading.

7.2.4 Use a ½ in. [13 mm] by ½ in. [13 mm] steel bar (in place of the key) whose length shall be sufficient to reach the outer edges of the sample unit across its length. The steel bar shall be placed adjacent and parallel to the sample mortar interface.

7.2.5 Evaluate shear bond results of actual bonding surface of unit as manufactured. If the back surface of the unit used for testing has a directional back pattern, this back pattern shall be parallel to the direction of loading.

7.3 **Absorption:**

7.3.1 At a minimum age of 28 days after manufacture, average absorption of three units shall be tested in accordance with Test Methods [C140](#). For the purposes of consistency, the results for any one unit shall not vary by more than 10 % from the average for all units. Units shall be permitted to be cut with a saw if the testing facility cannot accommodate a full-sized unit.

7.4 **Density:**

7.4.1 The saturated density of the units shall be determined from the weights obtained during absorption testing (in accordance with Test Methods [C140](#) and [7.3.1](#)) using the following calculation:

$$\frac{W_s - W_i}{W_s} \times 62.4 \text{ for inch-pound units}$$

$$\frac{W_s - W_i}{W_s} \times 1000 \text{ for SI units}$$