



Designation: C936/C936M – 23

Standard Specification for Solid Concrete Interlocking Paving Units¹

This standard is issued under the fixed designation C936/C936M; 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 the requirements for interlocking concrete pavers manufactured for the construction of paved surfaces.

1.2 Concrete units covered by this specification shall be made with lightweight or normal weight aggregates or both.

NOTE 1—If particular features are desired, such as weight classification, higher compressive strength, surface textures, finish, color, or other special features, such properties should be specified by the purchaser. Local sellers, however, should be consulted as to availability of units having the desired features.

1.3 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.

1.4 *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
- C207 Specification for Hydrated Lime for Masonry Purposes
- C331/C331M Specification for Lightweight Aggregates for

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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.

Concrete Masonry Units

- C418 Test Method for Abrasion Resistance of Concrete by Sandblasting
- C595/C595M Specification for Blended Hydraulic Cements
- C618 Specification for Coal 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
- C1240 Specification for Silica Fume Used in Cementitious Mixtures
- C1645 Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units

3. Terminology

3.1 Definitions:

3.1.1 *architectural finishes, n*—surface modified by mechanical means such as blasting, hammering, polishing, tumbling, washing, or other methods.

4. Materials

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

- 4.1.1 *Portland Cements*—Specification C150/C150M.
- 4.1.2 *Modified Portland Cement*—Portland cement conforming to Specification C150/C150M, modified as follows:
 - (1) *Limestone*—If calcium carbonate is added to the cement, the CaCO₃ content shall not be less than 85 %.
 - (2) *Limitation on Insoluble Residue*—1.5 %.
 - (3) *Limitation on Air Content of Mortar*—Volume percent, 22 % max.
 - (4) *Limitation on Loss on Ignition*—7 %.
- 4.1.3 *Blended Hydraulic Cements*—Specification C595/C595M.
- 4.1.4 *Hydraulic Cement*—Specification C1157/C1157M.
- 4.1.5 *Pozzolans*—Specification C618.
- 4.1.6 *Slag Cement*—Specification C989/C989M.
- 4.1.7 *Silica Fume*—Specification C1240.

4.2 *Aggregates*—Aggregates shall conform to the following specifications, except for the grading requirements:

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

4.2.1 *Normal Weight Aggregates*—Specification **C33/C33M**.

4.2.2 *Lightweight Aggregates*—Specification **C331/C331M**.

NOTE 2—The grading requirements of Specifications **C33/C33M** and **C331/C331M** may not be suitable for segmental concrete paving unit production. Because of this, producers are allowed to modify grading to meet their needs and the requirements of this specification.

4.3 *Pigments for Integrally Colored Concrete*—Specification **C979/C979M**.

4.4 *Other Constituents*—Air-entraining agents, integral water repellents, and other constituents shall be previously established as suitable for use in segmental concrete paving 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 segmental concrete paving units or any material customarily used in segmental pavement construction.

5. Physical Requirements

5.1 Units shall have an exposed face area $\leq 101 \text{ in.}^2$ [0.065 m^2], and their overall length divided by thickness shall be ≤ 4 . The minimum specified thickness shall be 2.36 in. [60 mm]. See Fig. 1.

5.2 Concrete units covered by this specification may be made from lightweight or normal weight aggregates or mixed lightweight and normal weight aggregates.

5.3 *Compressive Strength*—At the time of delivery to the work site, the average compressive strength of the test samples shall be not less than 8000 psi [55 MPa] with no individual unit less than 7200 psi [50 MPa] in accordance with 7.2.

5.4 *Absorption*—The average absorption of the test samples shall not be greater than 5 % with no individual unit greater than 7 % in accordance with 7.2.

5.5 *Resistance to Freezing and Thawing*—If the units are exposed to freezing and deicing materials during service, the manufacturer shall satisfy the purchaser either by proven field performance or a laboratory freezing-and-thawing test that the paving units have adequate resistance to freezing and thawing. If a laboratory test is used, sample and test in accordance with 7.2 using Test Method **C1645**. Specimens sampled from units that will not be exposed to deicing salts in service shall be tested in tap water. Specimens sampled from units that will be exposed to deicing materials in service shall be tested in 3 % saline solution. The average mass loss of all the specimens

tested shall not be greater than: (a) 225 g/m^2 when subject to 28 freeze-thaw cycles, or (b) 500 g/m^2 when subject to 49 freeze-thaw cycles.

NOTE 3—For some pavement applications subject to severe winter temperatures and deicing materials, a lower freezing temperature should be considered when conducting Test **C1645** using a 3 % saline solution. See the non-mandatory **Appendix X1** for this temperature option.

5.6 *Abrasion Resistance*—When requested by the specifier or purchaser, sample and test in accordance with 7.4 using Test Method **C418** or the manufacturer shall provide adequate record of field performance from a similar application. Specimens shall not have an average volume loss greater than $0.92 \text{ in.}^3/7.75 \text{ in.}^2$ [$15 \text{ cm}^3/50 \text{ cm}^2$]. The average thickness loss shall not exceed 0.118 in. [3 mm].

NOTE 4—Applications that may require testing include areas with severe abrasion, such as exposure to point loads from the repeated turning of hard rubber non-pneumatic wheels or heavy channelized foot traffic. Vehicular traffic usually does not constitute a severe abrasion condition.

5.7 *Dimensional Tolerance*—Measured length or width of test specimens shall not differ by more than $\pm 0.063 \text{ in.}$ [$\pm 1.6 \text{ mm}$] from the average of the measured dimensions of the specimens. Measured thickness of test specimens shall not differ by more than $\pm 0.125 \text{ in.}$ [$\pm 3.2 \text{ mm}$] from the specified dimension. All tests shall be performed in accordance with 7.2. Units shall meet dimensional tolerances prior to the application of architectural finishes.

6. Visual Inspection

6.1 All units shall be sound and free of defects that would interfere with the proper placing of the units or impair the strength or performance of the construction. Minor cracks incidental to the usual methods of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery shall not be deemed grounds for rejection.

7. Sampling and Testing

7.1 The purchaser or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from the lots ready for delivery. Prior to delivery of units, the supplier and purchaser shall decide on the lot size from which to sample test specimens for resistance to freezing and thawing, abrasion resistance, absorption, compressive strength, and dimensional tolerances.

7.2 Compressive strength, absorption, density, and dimensional tolerances shall be based on tests of solid concrete interlocking paving units of any configuration or dimensions manufactured with the same materials, concrete mix design, manufacturing process, and curing method, conducted in accordance with Test Methods **C140/C140M**, Annex A4, and not more than 12 months prior to delivery. Sample a minimum of three (3) test specimens each for compressive strength and absorption. Determine dimensional tolerances from either the compressive strength or absorption specimens prior to testing.

7.3 When required, freeze-thaw durability shall be based on tests of solid concrete interlocking paving units of any configuration or dimensions manufactured with the same materials, concrete mix design, manufacturing process, and

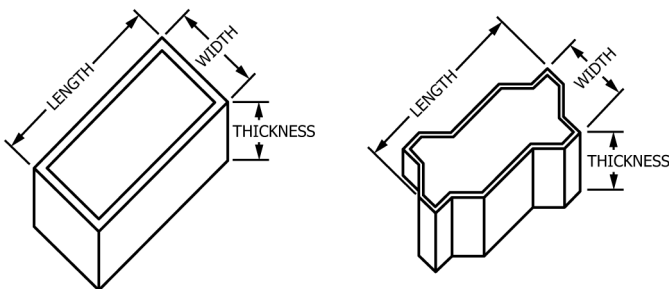


FIG. 1 Length, Width, and Thickness of Concrete Paving Units

curing method, conducted in accordance with Test Method **C1645** and not more than 24 months prior to delivery. Sample a minimum of three (3) test specimens each for freeze-thaw durability.

7.4 When required, abrasion resistance shall be based on tests of solid concrete interlocking paving units of any configuration or dimensions manufactured with the same materials, concrete mix design, manufacturing process, and curing method, conducted in accordance with Test Method **C418** and not more than 24 months prior to delivery. Sample a minimum of two (2) test specimens each for abrasion resistance.

8. Compliance

8.1 If a sample fails to conform to the specified requirements, the manufacturer shall be permitted to remove paving slabs from the shipment. A new sample shall be selected

by the purchaser from remaining units from the shipment with a similar configuration and dimension and tested. If the second sample meets the specified requirements, the remaining portion of the shipment represented by the sample meets the specified requirements. If the second sample fails to meet the specified requirements, the remaining portion of the shipment represented by the sample fails to meet the specified requirements.

NOTE 5—Unless otherwise specified in the purchase order, the cost of tests is typically borne as follows: (1) if the results of the tests show that the slabs do not conform to the requirements of this specification, the cost is typically borne by the seller; (2) if the results of the tests show that the units conform to the specification requirements, the cost is typically borne by the purchaser.

9. Keywords

9.1 concrete; concrete block paving unit; concrete paver; concrete paving unit; interlocking concrete paving unit; segmental concrete paving unit

APPENDIX

(Nonmandatory Information)

X1. OPTIONAL TEST METHOD FOR FREEZE-THAW DURABILITY

X1.1 *Scope*—This appendix provides information on using a lower freezing temperature that results in a more severe freeze-thaw durability test than that referenced in Section 5 of this standard and described in Test Method **C1645**.

X1.2 *Significance and Use*—Test Method **C1645** requires $-5 \pm 3^\circ\text{C}$ [$23 \pm 5^\circ\text{F}$] as the lowest temperature during laboratory freeze-thaw test cycles. To provide increased severity during freeze-thaw durability testing for pavement applications exposed to deicing materials, this appendix provides $-15 \pm 3^\circ\text{C}$ [$5 \pm 5^\circ\text{F}$] as the freezing temperature for specimens tested in a 3 % saline solution in accordance with Test Method **C1645**.

X1.3 *Application*—Applying $-15 \pm 3^\circ\text{C}$ [$5 \pm 5^\circ\text{F}$] in Test Method **C1645** is determined by the location of a project in terms of the climate zones shown in the map in Fig. X1.1 (see Note X1.1). The following guidelines apply to Test Method **C1645** according to the climate zone conditions:

(1) Zone 1: Non-freezing conditions; no freeze-thaw test is required in accordance with 5.5.

(2) Zone 2: Moderate freezing conditions; test in accordance with Test Method **C1645** with no change in the required freezing temperature; that is; use a freezing temperature of $-5 \pm 3^\circ\text{C}$ [$23 \pm 5^\circ\text{F}$]. The mass loss criteria applies in accordance with 5.5.

(3) Zone 3: Severe freezing conditions; test in accordance with Test Method **C1645** except use a freezing temperature of $-15 \pm 3^\circ\text{C}$ [$5 \pm 5^\circ\text{F}$]. The mass loss criteria applies in accordance with 5.5.

NOTE X1.1—The weather zone map in Fig. X1.1 is essentially the same as Figure 1, Location of Weathering Regions in Specification in **C33/C33M**. Climate Zones 1, 2 and 3 in Fig. X1.1 correspond to the Negligible, Moderate and Severe weathering regions, respectively, of Figure 1 in Specification **C33/C33M**.

X1.4 *Reporting*—Report the use of optional $-15 \pm 3^\circ\text{C}$ [$5 \pm 5^\circ\text{F}$] freezing temperature with mass lost in accordance with Test Method **C1645** in the freeze-thaw durability test results.