Designation: C1491 – 14

Standard Specification for Concrete Roof Pavers[1]

This standard is issued under the fixed designation C1491; 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 concrete roof pavers that are machine-made from hydraulic cement, water, and suitable mineral aggregates with or without the inclusion of other materials, for use as roof ballast and protection of roof membranes.

NOTE 1—The design of roof ballast 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C33 Specification for Concrete Aggregates
C140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C150 Specification for Portland Cement
C331 Specification for Lightweight Aggregates for Concrete Masonry Units
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1157 Performance Specification for Hydraulic Cement
C1209 Terminology of Concrete Masonry Units and Related Units (Withdrawn 2009)[3]
C1232 Terminology of Masonry
C1262 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 C1209 and Terminology C1232 shall apply to this specification.

4. Material

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

4.1.1 *Portland Cement*—Specification C150.

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

4.1.2.1 *Limestone*—Limestone, with a minimum 85 % calcium carbonate ($CaCO_3$) content, shall be permitted to be added to the cement, provided the requirements of Specification C150 are modified as follows:

(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 Cements*—Cement conforming to either Specification C595 or Specification C1157.

4.1.4 *Pozzolans*—Specification C618.

4.1.5 *Blast Furnace Slag*—Specification C989.

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 C33.

4.2.2 *Lightweight Aggregates*—Specification C331.

4.3 *Other Constituents*—Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and

[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] 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

other constituents shall be previously established as suitable for use in concrete roof pavers and shall conform to applicable ASTM standards or shall be shown by test or experience satisfactory to the purchaser to be not detrimental to the durability of the units or any material customarily used in concrete roof pavers.

5. Physical Requirements

5.1 At the time of delivery to the work site, the units shall conform to the physical requirements of Table 1 when tested in accordance with 8.2.

5.2 *Resistance to Flexural Load*—The average resistance to flexural load for three paver units shall exceed 350 lb (1557 N) and resistance to flexural load of each individual unit shall exceed 280 lb (1246 N) when tested in accordance with 8.2.

5.3 *Ballast Weight*—Requirements for ballast weight per unit area shall be specified separately.

5.4 *Freeze-Thaw Durability*—In areas where repeated freezing and thawing under saturated conditions occur, freeze-thaw durability shall be demonstrated by test or by proven field performance that the concrete roof paver units have adequate durability for the intended use. When testing is required by the specifier to demonstrate freeze-thaw durability, the units shall be tested in accordance with 8.3.

5.4.1 Specimens shall comply with either of the following: *(1)* the weight loss of each of five test specimens at the conclusion of 100 cycles shall not exceed 1 % of its initial weight; or *(2)* the weight loss of each of four or five test specimens at the conclusion of 150 cycles shall not exceed 1.5 % of its initial weight.

NOTE 2—This specification does not include criteria for hail stone impact. Where required, these criteria should be specified by the purchaser. Appendix X1 is provided as guidance to specifying hail-impact resistance.

6. Permissible Variations in Dimension and Weight

6.1 Overall dimensions for width, height, and length shall not differ by more than ±⅛ in. (3.2 mm) from the specified standard dimensions.

6.2 Ballast weight shall not differ by more than ±2.0 lb/ft^2 (9.7 kg/m^2) from the specified weight.

7. Finish and Appearance

7.1 All units shall be sound and free of cracks or other defects that would interfere with the proper placement of the unit or would 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 Five percent of the units in a shipment are permitted to contain 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.

7.3 A shipment shall not contain more than 5% of units, including broken units, that do not meet the requirements of 6.1 and 7.2.

8. Sampling and Testing

8.1 The purchaser or authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from the lots ready for delivery.

8.2 Compressive strength, flexural load, absorption, density, ballast weight and dimensional tolerances shall be based on tests of concrete roof pavers of any configuration or dimensions made with the same materials, concrete mix design, manufacturing process, and curing method, conducted in accordance with Test Methods C140 and within 12 months of production of the units.

8.3 When required, freeze-thaw durability shall be based on tests of concrete roof pavers of any configuration or dimension made with the same materials, concrete mix design, manufacturing process, and curing method, conducted in accordance with Test Method C1262 and within 24 months of production of the units.

9. Compliance

9.1 If a sample falls to conform to the specified requirements, the manufacturer shall be permitted to remove units 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 at the expense of the manufacturer. 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 3—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 units 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

TABLE 1 Physical Requirements

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 Unit	Average of 3 units	Individual Unit
Lightweight	95 (1522) or less	15 (240)	17 (272)	3000 (20.7)	2600 (17.9)
Medium Weight	Over 95 to 115 (1522 to 1842)	13 (208)	15 (240)	3000 (20.7)	2600 (17.9)
Normal Weight	Over 115 (1842)	10 (160)	12 (192)	3000 (20.7)	2600 (17.9)

units conform to the specification requirements, the cost is typically borne by the purchaser.

10. Keywords

10.1 absorption; aggregates; ballast weight; cementitious; compressive strength; concrete roof pavers; durability; limestone; portland cement

APPENDIX

(Nonmandatory Information)

X1. SPECIFYING RESISTANCE TO HAIL STONE IMPACT

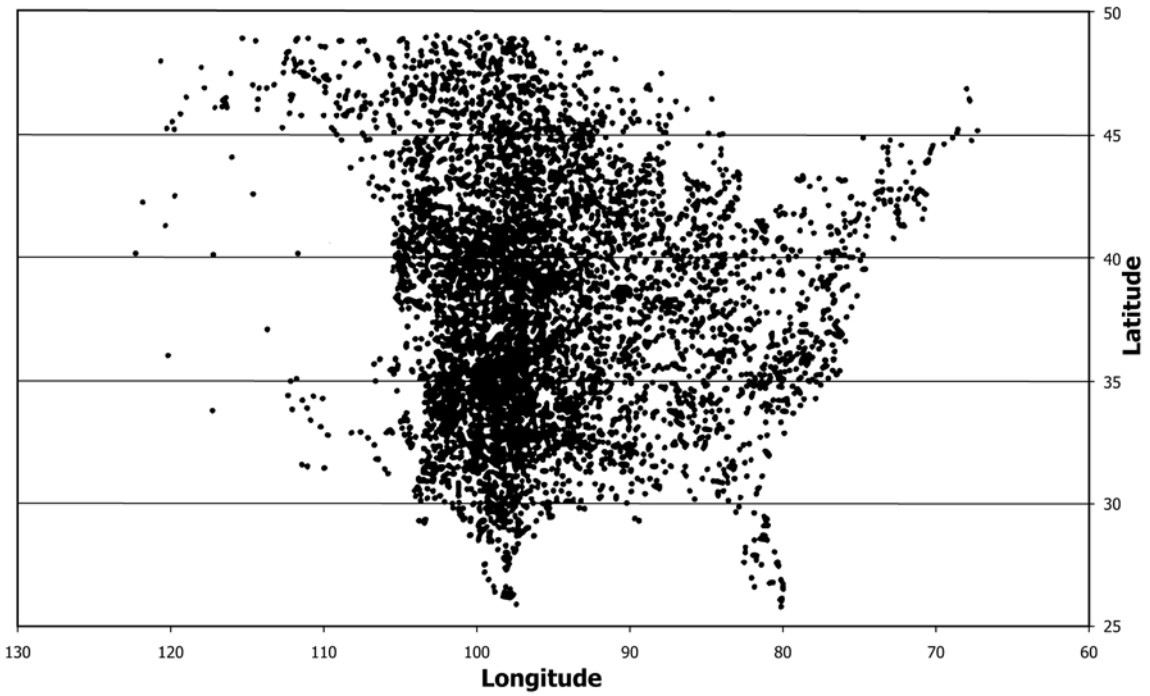

FIG. X1.1 Hail Storm Frequency

X1.1 Where the purchaser's deign criteria include resistance to impact from hail, hailstorm activity can be estimated from Fig. X1.1. As further guidance, a minimum energy-impact resistance to hail stones in areas potentially subjected to moderate to heavy hailstorm activity shall be 15 ft-lb (20.3 J). This impact energy is related to a hail stone of approximate diameter of 1.83 in. (46.5 mm), having a density 90 % of that of water, and falling at the terminal velocity for a spherical shape. Fig. X1.1 is based on hail storm activity reported by the National Weather Service for the time period between 1955 and 1995 and includes all reported hail storms with average hail stone diameter 1.8 in. (45.7 mm) or larger.

X1.2 Recommended testing for hail stone impact resistance entails impacting three specimens, supported as they would be in use, each to a series of three blows from a spherical ice ball of a size, configuration, and impact energy as outlined above. Failure of any specimen would be defined as the complete fracturing of the test specimen through the height of the paver. (Dents, chips, or cracks shall not be considered as failure of the test specimen.)

SUMMARY OF CHANGES

Committee C15 has identified the location of selected changes to this standard since the last issue (C1491 – 13) that may impact the use of this standard. (December 1, 2014)

(1) Revised Section 8 to add a 12-month frequency for C140 tests.