



Designation: **E2396 – 11** E2396/E2396M – 15

## Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Vegetative (Green) Roof Systems<sup>1</sup>

This standard is issued under the fixed designation E2396/E2396M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers a procedure for determining the water permeability of coarse granular materials used in the drainage layers of vegetative (green) roof systems.

1.2 This test method addresses water permeability under the low-head conditions that typify horizontal flow in vegetative (green) roof applications.

1.3 This test method is suitable for coarse-grained materials with 100 % of the material retained on the U.S. #8 (2.25 mm) [2.25 mm] sieve. It is not suitable for finer-grained materials.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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 *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 to determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

**C29/C29M** Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

**C130** Specification for Lightweight Aggregates for Concrete (Withdrawn 1954)<sup>3</sup>

**E631** Terminology of Building Constructions

**E2114** Terminology for Sustainability Relative to the Performance of Buildings

### 3. Terminology

3.1 *Definitions:*

3.1.1 For terms related to building construction, refer to Terminology **E631**.

3.1.2 For terms related to sustainability relative to the performance of buildings, refer to Terminology **E2114**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *water permeability*—the coefficient which when multiplied by the hydraulic gradient will yield the apparent velocity with which water (at 68°F) will move through a cross-section of media.

3.2.2 *wet density*—the density of coarse granular drainage course materials determined after immersion for 24 hours.

### 4. Summary of Test Method

4.1 This procedure involves measuring the water permeability of coarse granular materials under the low-head conditions that characterize the environment in vegetative (green) roof systems. A falling-head technique is used. Incidental to the procedure is the measurement of the wet density of the medium.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee **D08** on Roofing and Waterproofing and is the direct responsibility of Subcommittee **D08.24** on Sustainability.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

**5. Significance and Use**

5.1 This test method addresses performance characteristics for vegetative (green) roof systems with respect to the water permeability of the drainage media.

5.1.1 Water permeability of coarse materials is highly influenced by the head conditions under which it is measured. In vegetative (green) roofs, coarse materials are frequently used to create drainage zones for percolated rainfall.

5.1.2 This test method is intended to provide water permeability data that is relevant to this design condition that is characterized by horizontal flow under low-head. This will also allow the performance of granular drainage layers in vegetative (green) roof systems to be compared directly to alternative components, such as geocomposite drain layers.

5.2 Determining the performance characteristics of vegetative (green) roof systems provides information to facilitate the assessment of related engineering aspects of the facility. Such aspects may include structural design requirements, mechanical engineering and thermal design requirements, and fire and life safety requirements.

5.3 Determining the performance characteristics of vegetative (green) roof systems provides information to facilitate assessment of the performance of one vegetative (green) roof system relative to another.

**6. Apparatus**

6.1 The apparatus consists of nested cylinders constructed from stainless steel or plastic:

6.1.1 *Inner cylinder*—inner diameter of 3.75 in. (9.53 cm), 32 in. (81.3 cm) long as shown in Fig. 1. Perforated at the bottom (50 % open area), with marks at 6 and 8 in. (15.2 and 20.3 cm) below the top of the cylinder,

6.1.2 *Outer cylinder*—inner diameter of 5.75 in. (14.6 cm) as shown in Fig. 1. This cylinder must be watertight,

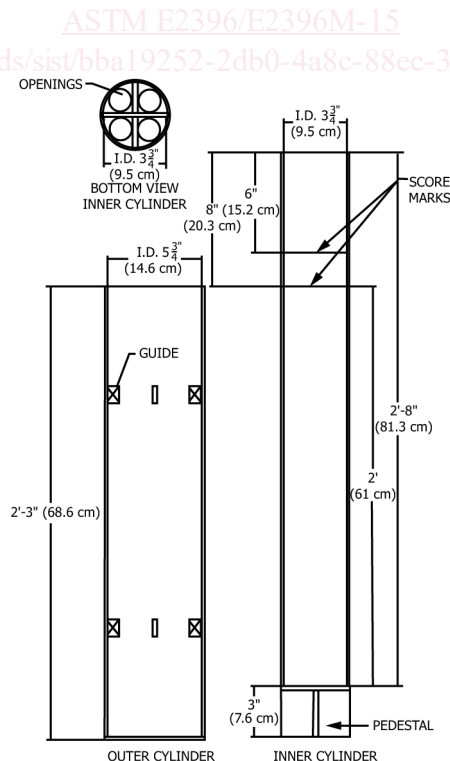
6.1.3 U.S. #8 (2.25 mm) sieve disc, 3.55-in. (9.02-cm) diameter, and

6.1.4 Scale with accuracy of 0.005 oz (0.14 g).

6.2 The apparatus is mounted so that the 8-in. (15.2-cm) mark of the inner cylinder is level with the top of the outer cylinder.

**7. Conditioning**

7.1 Before conducting the tests, with the sieve in place, fill the apparatus with water and determine the elapsed time in seconds that it takes for the water level to fall 6 in. (15.2 cm) to the first mark. This value will be used to establish the upper limit on the measurement of water permeability using the apparatus.



**FIG. 1 Equipment Fabrication Detail**