Designation: C1794 – 19

Standard Test Methods for Determination of the Water Absorption Coefficient by Partial Immersion[1]

This standard is issued under the fixed designation C1794; 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 test method defines a procedure to determine the water absorption coefficient of a material by partial submersion. The scope is to evaluate the rate of absorption of water due to capillary forces for building materials in contact with normal or driving rain above grade. The procedure is typically suitable mainly for masonry material, plaster, or a coating in combination with a substrate; but it can also be used for insulation materials. This test method is designed to be used only on homogeneous materials and does not apply to materials that are composites or non-homogeneous (for example, Faced Rigid Closed-cell Insulation). It is not within the scope of this standard to determine liquid uptake phenomena in below-grade applications. The water absorption coefficient is mainly used as an input datum for numerical simulation of the combined heat and moisture transport in building envelopes for design and forensic investigation purposes.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined. However, derived results can be converted from one system to the other using appropriate conversion factors (see Table 1).

1.3 *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.*

1.4 *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]

C168 Terminology Relating to Thermal Insulation

2.2 *Other Standards:*[3]

ISO 9346 Hygrothermal performance of buildings and building materials—Physical quantities for mass transfer—Vocabulary

ISO 15148 Determination of water absorption coefficient by partial immersion

3. Terminology

3.1 *Definitions of Terms*—For definitions associated with thermal insulation issues refer to Terminology C168. For definitions associated with water absorption refer to the terms and definitions given in ISO 9346.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *homogeneous material, n*—materials, which properties are uniform on a macroscopic scale.

3.2.2 *water absorption coefficient, n*—mass of water absorbed by a test specimen per face area and per square root of time (see Eq 2).

3.3 *Symbols and Units*—the Symbols and Units shown in Table 2 are used.

4. Summary of Test Method and Use

4.1 Water absorption by partial submersion will be calculated by measuring the change in weight of the specimen in a situation when the bottom surface is in contact with liquid water. Liquid water that is only adsorbed on the surface shall not be taken into account and shall be removed before weighing, for example, by blotting with a sponge.

4.2 The purpose is of this test is to derive reliable data on the capillary water uptake of building materials in appropriate units using a simple apparatus. These data can also be used as

[1] This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.33 on Insulation Finishes and Moisture.

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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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 1 Metric Units and Conversion Factors[A]

Multiply	by	To Obtain (for the same test condition)
	Area	
m^2	10.8	ft^2
ft^2	9.29×10^{-2}	m^2
	Mass	
kg	2.20	lb
lb	0.454	kg
	Mass per Area	
kg/m^2	0.205	lb/ft^2
lb/ft^2	4.88	kg/m^2
	Water Absorption Coefficient	
$kg/(m^2 \cdot \sqrt{s})$	0.205	$lb/(ft^2 \cdot \sqrt{s})$
$lb/(ft^2 \cdot \sqrt{s})$	4.88	$kg/(m^2 \cdot \sqrt{s})$

[A] The IP unit system includes several meanings of the pound unit lb. In this standard the unit lb refers to pound mass only.

TABLE 2 Symbols and Units[A]

Symbol	Quantity	SI unit	IP unit
A	Face Area	m^2	ft^2
A_w	Water Absorption Coefficient	$kg/(m^2 \cdot \sqrt{s})$	$lb/(ft^2 \cdot \sqrt{s})$
A_{w4}	Water Absorption Coefficient, related to a time of 4 h	$kg/(m^2 \cdot \sqrt{s})$	$lb/(ft^2 \cdot \sqrt{s})$
Δm_t	mass gain per face area after time t	kg/m^2	lb/ft^2
M_i	Initial mass of specimen	kg	lb
m_t	Mass of specimen after time t	kg	lb
m_i	Starting mass	kg	lb
t	Time	s or h	h

[A] The IP unit system includes several meanings of the pound unit lb. In this standard the unit lb refers to pound mass only.

material properties for hygrothermal simulation of the building envelope for design and forensic purposes.

5. Significance and Use

5.1 The purpose of these tests is to obtain, by means of simple apparatus, reliable and easy to determine values of liquid water transport for capillary active materials expressed in suitable units. These values are for use as part of the material properties in hygrothermal analysis tools for building envelope design and forensic studies. As the topic of liquid transport phenomena in porous materials is very complex, Appendix X1 in ISO 15148 shows some more detailed background information.

6. Apparatus

6.1 The apparatus must contain the following:

6.1.1 A scale to measure the weight of the specimen with an accuracy within ±0.1 % of the specimen's mass.

6.1.2 A water tank with a regulation system to keep the water level constant within ±3 mm (±⅛ in.) and equipment to keep the position of the specimen at least 5 mm (¼ in.) above the bottom of the tank without harming the specimen.

6.1.3 Equipment to measure the time with accuracy of at least 1 second.

7. Test Specimen

7.1 *Shape*—The shape shall represent typical material dimensions and must have a constant area to ensure one-dimensional moisture flow. The surfaces shall be as flat as possible.

7.2 *Area*—The area which is in contact with the water must be at least 50 cm^2 (8 $in.^2$). However, in the case of materials including macroscopic particles such as aggregates, the side of a square specimen or the smallest diameter of the face shall be at least ten times the largest particle size. Influences of irregular surface structures shall be neglected if those irregular surface structures are part of the materials' design.

NOTE 1—Larger specimens, preferably with a face area of at least 100 cm^2 (16 $in.^2$), are advised as they will lead to greater accuracy.

7.3 *Thickness*—Where possible, use a specimen thickness which represents the full product thickness. When specimens are cut from products they shall be representative of the material to be assessed and thick enough to enable handling without damage. In the case of materials including macroscopic particles such as aggregates, it is preferable that the thickness be at least ten times the largest particle size, but shall be no less than five times, the largest particle size.

7.4 *Number*—At least three specimens shall be tested. If the water contact area of the individual specimens is less than 100 cm^2 (16 $in.^2$), at least six specimens shall be tested representing a total area of at least 300 cm^2 (47 in^2).

7.5 *Preparation*—Test specimens shall be representative of the whole material and shall be cut so that they do not include product edges. In the case of materials known to be non-isotropic, sets of test specimens shall be prepared in all orientations of the potential use of the material. The test specimens shall be prepared by methods that do not change the original structure of the product; any skins, facings or coatings shall be retained. In the case of products such as coatings, thin rendering or plasterwork that are normally adhered to a substrate in use, specimens shall be made up from the product and a normal substrate combined. The total thickness then is the sum of the coating and the substrate. The sides of a solid specimen shall be sealed with a water and vapor tight sealant that does not react chemically with it or significantly penetrate the pores of the product as shown in Fig. 1. It is especially important that the sides of specimens with surface coatings are sealed to prevent bypassing of the coating. If sealing is not possible in the case of very low density fibrous or loose fill materials place them in a tightly fitting tube supported on a wire mesh placed over the mouth of the tube. The open area of the mesh shall be as large as possible while completely supporting the sample during the whole course of the test. In this case, to minimize the edge effects, the face area of the specimen shall be at least 100 cm^2 (16 in^2). The surface in contact with the water shall be plane, allowing for the normal surface roughness of the material.

7.6 *Conditioning*—The test specimens shall be stored under the test conditions (see 8.1) until the mass of each specimen has stabilized to within 0.1 % of its total mass, when measured over 24 h. In case the stability of 0.1 % of mass cannot be reached, additionally the relative humidity shall be controlled, for example, by using a climatic-controlled room or chamber, to be within 50 % ± 5 % and furthermore the specimen must be exposed to these conditions until the end of the measurement except of the short time of the weighing process.