Designation: ~~E3075 – 16~~ E3075 – 18

# Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance [1]

This standard is issued under the fixed designation E3075; 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 performance of construction materials during flood events is an item of importance for property owners and communities, especially those located in flood-prone areas. Requirements for the use of flood-resistant building materials in flood hazard areas can be found in the ~~US~~U.S. model codes, standards, and guidelines pertaining to flood resistant design and construction. To promote uniformity in evaluation of building material response to flooding, this test method prescribes standard conditions for water immersion, subsequent drying, and cleaning such as occur during flood events. Other deleterious effects of floods that are outside the scope of this test method include, but are not limited to, debris impact, flood velocity, wave action, water pressure differential, scour, erosion, biological and chemical contaminants in floodwater, and other factors including long-term occupant health impacts that would be adverse to continued use of the structure.



## 1. Scope

1.1 This test method is intended to apply to building materials used in construction below the base flood elevation (BFE) including, but not limited to: individual building materials and composite assemblies of building materials that constitute permanent integral parts of a finished building including walls, floors, ceilings, stairways, built-in partitions, finishes, cladding, and other similarly incorporated architectural and structural items.

1.2 Requirements for evaluation of other hazards associated with flood damage including, but not limited to: debris impact, flood velocity, wave action, water pressure differential, scour, erosion, biological and chemical contaminants in floodwater, and other factors that would be adverse to continued use of the structure for its intended purpose including long-term occupant health impacts are outside of the scope of the methods presented herein.



1.3 The water immersion, drying, and cleaning procedures specified in this test method establishes standard conditions for laboratory evaluation of test specimen response to water immersion, subsequent drying, and cleaning. The results of these tests are one factor in assessing the characteristics of building materials with regard to water immersion, drying, and ability to be cleaned. Application of these test results to predict these characteristics for actual building construction requires the evaluation of test conditions as compared to conditions of end-use.

1.4 The water immersion and drying procedures shall not be construed as representative of water makeup, duration of immersion, or conditions of drying during an actual flood event because actual flood conditions vary with such factors as makeup of water, depth and duration of immersion, and ambient temperature and humidity.

1.5 The cleaning procedures specified in this test method are intended to simulate surface cleaning that normally occurs after flooding.

1.6 The cleaning procedures specified in this test method shall not be construed as superseding standards or manufacturer's recommended methods for cleaning and restoration after flooding.

1.7 A commentary to this test method is provided in Appendix X1.

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[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.25 on Whole Buildings and Facilities.

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1.8 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.

1.9 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.10 *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 ~~Standard:~~Standards:*[2]

D7789 Practice for Collection of Fungal Material from Surfaces by Swab

E631 Terminology of Building Constructions

2.2 *Federal Standard:*[3]

44 CFR Part 60.3 Flood plain management criteria for flood-prone areas

2.3 *Other Standards:*

ANSI/IICRC S500 Standard and Reference Guide for Professional Water Damage Restoration[4]

International Plumbing Code [5]

## 3. Terminology

3.1 *Definitions*—For definitions of general terms related to building construction used in this test method, refer to Terminology E631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *base flood elevation (BFE), n*—the height of the base (1-percent annual chance or 100-year) flood in relation to a specified datum, usually the National Geodetic Vertical Datum of 1929, or the North American Vertical Datum of 1988.

3.2.2 *potable tap water, n*—filtered tap water conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

## 4. Summary of Test Method

4.1 The procedures described in this test method are used to evaluate the response of building materials noted in 1.1 when subjected to water immersion, subsequent drying, and cleaning.

4.1.1 This test method exposes test specimens to water immersion followed by a drying period and surface cleaning.

4.1.2 Test specimen orientation is consistent with orientation of the test specimen building material(s) in end use. For example, a test specimen simulating wall assembly construction is immersed in a vertical orientation, while a test specimen simulating floor/ceiling assembly construction is immersed in a horizontal orientation.

4.1.3 The cleaning specifications are intended to simulate surface cleaning that normally occurs after flooding.

## 5. Significance and Use

5.1 This test method establishes water immersion, drying, and cleaning procedures to be used when determining whether building materials noted in 1.1 are flood damage resistant for applications that comply with the National Flood Insurance Program (NFIP) [44 CFR § 60.3(a)(3)].

5.2 This test method exposes the test specimen to water immersion and drying conditions to simulate the effects of wetting and subsequent drying that occurs with a flood event. The wetting and drying exposure is followed by surface cleaning. This test method provides a measure of how test specimens may respond to water immersion, subsequent drying, and cleaning that occur with flood events.

5.3 This test method is useful for determining water absorption characteristics of different test specimens in terms of percent increase in test specimen weight, their drying characteristics in terms of elapsed time to dry to equilibrium weight, and changes in physical appearance following water immersion and surface cleaning.

5.4 This test method is useful in comparing the water absorption characteristics of different test specimens, their drying characteristics, and changes in physical appearance following water immersion and surface cleaning. This test method is also useful in comparing test specimen physical dimensions before water immersion, immediately following removal from water immersion, after drying, and after cleaning.

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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~~standard's Document Summary page on the ASTM website.

[3] Available from U.S. Government Publishing ~~Office,~~ Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.access.gpo.gov.

[4] Available from Institute of Inspection Cleaning and Restoration Certification (IICRC), 4043 South Eastern Avenue, Las Vegas, NV 89119, http://www.iicrc.org.

[5] Available from, and a registered trademark of, International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.

5.5 The ability to directly compare test results will vary by many factors including test specimen size and whether test specimens are individual building materials or composite assemblies of building materials.

## 6. Test Specimens

6.1 The test specimens shall be identified as fully as possible by including the building materials and details of construction, method of fabrication, and other pertinent details that potentially affect the response to water immersion, drying, and cleaning.

NOTE 1—Test specimens can vary in size and makeup depending on the purpose of the testing. Where the purpose of testing is to evaluate the response of a particular building material to exposures in this test method, test specimen can consist solely of the building material of interest. Such test specimens enable evaluation of the building material alone without influence by water absorption, drying, and dimensional change characteristics of other building materials that are used in test specimens consisting of a composite assembly of building materials. Where the purpose of testing is to evaluate the response of a composite assembly of building materials to exposures in this test method to more closely address conditions representative of end use, test specimens can consist of a composite assembly of building materials as used such as occur in wall or floor/ceiling assembly construction.

6.2 Where applicable based on the purpose of testing, test specimens shall include joints, fasteners, adhesives, and other materials as appropriate to the end-use.

6.3 Before water immersion, test specimens shall be conditioned in a controlled environment at 75 ± 5 °F (24 ± 3 °C) and 50 ± 5 % relative humidity (RH) until the equilibrium weight for the test specimen is achieved. Periodic weighing shall be used to make a determination regarding whether equilibrium weight is achieved.

6.3.1 The equilibrium weight, $W_{initial}$, shall be determined before water immersion.

NOTE 2—In practice, RH control is not exact and fluctuations occur during the conditioning period. Since change in weight because of RH fluctuation is usually small relative to the total change that a test specimen will experience, a steady increase or decrease in mass will generally occur during most of the conditioning period. As the test specimen approaches equilibrium weight, weight change associated with fluctuations in RH will cause a change in the direction of weight change, which is a sign that equilibrium weight has been reached. The reversal of direction of weight change can be used for equilibrium weight determination. A minimum of three results confirming the reversal is recommended.

## 7. Water Specifications

7.1 Water shall be filtered potable tap water at 75 ± 5 °F (24 ± 3 °C) having a pH within the range of 6.0 to 9.0 and greater than 95 % of chlorine and fluorides removed with sewage surrogate, mold surrogates, and nutrients added in the quantities specified as follows:

7.1.1 *Sewage Surrogate*—$10^6 \pm 0.05 \times 10^6$ MPN/L Escherichia coli;

7.1.2 *Mold Surrogates*—$10^6 \pm 0.05 \times 10^6$ cfu/L Penicillium brevicompactum, $10^6 \pm 0.05 \times 10^6$ cfu/L Aureobasidium pullulans, and $10^6 \pm 0.05 \times 10^6$ cfu/L Eurotium herbariorum; and

7.1.3 *Nutrients*—0.1 % (weight/volume) potato dextrose extract.

7.2 In this test method, references to water in which test specimens are immersed indicates use of water in accordance with specifications in 7.1.



## 8. Procedure

8.1 *Water Immersion*—Immerse test specimens in water in accordance with specifications in 7.1 to the level specified in 8.1.2 for a period of not less than 72 h nor more than 80 h.

8.1.1 *Apparatus*—A corrosion resistant tub or container, clean and free of debris, shall be used for soaking test specimens and shall be of adequate size to accommodate water immersion of test specimens as required in this test method.

8.1.2 *Test Specimen Orientation:*

8.1.2.1 Where end-use is in a vertical orientation (for example, a wall assembly specimen), immerse test specimens to 50 ± 10 % of the height of the specimen.

8.1.2.2 Where end-use is in a horizontal orientation (for example, a floor or ceiling assembly specimen), immerse such that no portion of the test specimen is less than 1 in. (25 mm) below the surface of the water.

8.1.3 The test specimens shall be placed on supports capable of supporting the test specimens off the bottom of the water bath while submerged to the specified depth. For test specimens that may otherwise float, weights or other methods of keeping test specimens submerged to the specified depth shall be used.

8.2 *Water Absorption*—Compute water absorption as a percent increase over the initial pre-immersion test specimen weight as:

$$WA = \frac{W_{wet} - W_{initial}}{W_{initial}} \times 100 \quad (1)$$

where:

$WA$ = Percent increase in test specimen weight due to water immersion;
$W_{wet}$ = Weight of wet test specimen measured within 1 h after removal from water immersion, g; and
$W_{initial}$ = Equilibrium weight of test specimen before water immersion, g.

NOTE 3—The weight increase after water immersion can be determined by subtracting $W_{initial}$ from $W_{wet}$. When other characterizations of water absorption are reported, such as ratio of weight increase to the dry volume of the test specimen, it is important to describe the basis for determination