



Designation: C1918 – 21

Standard Test Method for Water Retention of Rigid Thermal Insulation Materials after Immersion and Exposure to Drying Conditions¹

This standard is issued under the fixed designation C1918; 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 determines the amount of water retained (excluding surface water) by flat specimens of rigid thermal insulations after immersion and exposure to drying conditions. This test method is intended to be used for the characterization of materials in the laboratory. It is not intended to simulate any particular environmental condition potentially encountered in building construction applications.

1.2 This test method does not address all the possible mechanisms of water intake and retention and related phenomena for rigid thermal insulations. It relates only to those conditions outlined in 1.1. Determination of moisture accumulation in thermal insulations due to partial immersion, water vapor transmission, internal condensation, freeze-thaw cycling, or a combination of these effects requires different test procedures.

1.3 This test method does not address or attempt to quantify the drainage characteristics of materials.

1.4 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, each system shall be used independently of the other. Combining values from the two systems has the potential to 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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.*

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.

Current edition approved Dec. 1, 2021. Published January 2022. DOI: 10.1520/C1918-21.

2. Referenced Documents

2.1 *ASTM Standards*:²

C168 Terminology Relating to Thermal Insulation

C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation

C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation

3. Terminology

3.1 *Definitions*—Terminology C168 applies to terms used in this test method.

4. Summary of Test Method

4.1 Test specimens are immersed in water for 24 h and subsequently exposed to drying conditions for minimum of 24 h. Water absorption is determined after the immersion period and water retention is determined after the exposure to drying period.

5. Significance and Use

5.1 This test method provides a means of measuring the water retention of flat specimens of rigid thermal insulation as a result of immersion in water and exposure to drying conditions.

6. Apparatus

6.1 *Temperature-Controlled Room or Chamber*, suitable for maintaining temperature within $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$).

6.2 *Temperature and Humidity-Controlled Room or Chamber*, suitable for maintaining temperature within $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$) and relative humidity within $\pm 5\%$.

6.3 *Caliper, Dial Gage, or Micrometer*, suitable for measuring specimen dimensions to within 0.1 %.

6.4 *Balance*, suitable for measuring specimen weight to within 0.1 %.

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.

6.5 *Immersion Pan*—A pan of width and length of at least 400 mm (16 in.) and of a depth at least 50 mm (2 in.) greater than the specimen thickness.

6.5.1 *Specimen Supports and Constraints*—Included in the construction of the immersion pan shall be a means for securing the specimens in a level position, a noncorrosive support for the bottom surface of the specimens and a similar constraining device for the top surface for buoyant materials. The support and constraining devices shall not contact more than 15 % of the specimen surfaces. The space between the support and the bottom of the pan shall be not less than 5 mm (0.2 in.). The pressure exerted on the specimens by the constraining device for the top surface shall be limited to that required to counteract any buoyant force exerted by the specimens at the beginning of the test.

6.6 *Water*, distilled, deionized or reverse osmosis.

7. Sampling, Test Specimens, and Test Units

7.1 Specimen dimensions shall be 300 mm \pm 3 mm by 300 mm \pm 3 mm by thickness supplied (12 \pm 1/8 in. by 12 \pm 1/8 in. by thickness supplied).

NOTE 1—Materials intended for use with natural or laminated skin surfaces should be tested with skins intact.

7.2 Three specimens shall be tested.

8. Preparation of Apparatus

8.1 Fill the immersion pan with water sufficient to maintain a 25 mm (1 in.) head of water over the specimen top surface at all times during the test.

8.2 Place filled immersion pan in a temperature-controlled room or chamber with a temperature of 23 \pm 2°C (73 \pm 4°F) and allow the water to reach a steady temperature.

9. Conditioning

9.1 Condition specimens in a temperature and humidity-controlled room or chamber with a temperature of 23 \pm 2°C (73 \pm 4°F) and a relative humidity of 50 \pm 5 % until the change in specimen mass after a 24-h period is less than 0.1 % of the specimen mass.

10. Procedure

10.1 Measure specimen dimensions and weight per Test Method C303. This weight is the initial weight, W_1 . The weight is measured in either the temperature-controlled room or chamber.

10.2 Submerge each specimen horizontally in the immersion pan under 25 \pm 2 mm (1 \pm 0.1 in.) of water. Specimens shall be placed on the specimen supports described in 6.5.1. For buoyant materials, the specimen constraints described in 6.5.1 shall be used.

10.3 During the test the immersion pan shall remain in the temperature-controlled room or chamber with a temperature of 23 \pm 2°C (73 \pm 4°F).

10.4 After 24 h \pm 15 min, remove the specimens from the water and remove surface water by blotting with a paper towel not to exceed two seconds per surface.

10.5 Measure each specimen's weight. This weight is the intermediate weight, W_2 .

10.6 Within 15 min after the removal from the water, place specimens horizontally in temperature and humidity-controlled room or chamber, with a temperature of 23 \pm 2°C (73 \pm 4°F) and a relative humidity of 50 \pm 5 %. Air shall be continuously circulated to maintain uniform conditions. Turbulent air flow shall be avoided. Specimen supports shall not restrict air flow to more than 15 % of the supported specimen surface.

NOTE 2—The use of an open-air room within specified conditions is recommended. The use of an environmental chamber is acceptable if air flow is determined to not be turbulent.

10.7 After 24 h \pm 15 min, weigh each specimen. This weight is the final weight after immersion and drying, W_3 . The weight is measured in the temperature-controlled room or chamber.

10.8 *Optional*—The specimen is returned to the conditions of 10.6 and subsequent measurements are completed at 24 h periods in accordance with 10.7.

11. Calculation of Results

11.1 Definitions of Symbols:

W_1 = conditioned weight, g (lb).

W_2 = intermediate weight, g (lb).

W_3 = final weight, g (lb).

P = density of material, g/cm³ (lb/ft³).

ρ_w = density of water, g/cm³ (lb/ft³).

11.2 Calculate density per Test Method C303.

11.3 Calculate the percent water absorbed by weight as:

$$\% \text{water absorbed by weight} = 100 \times (W_2 - W_1) / W_1 \quad (1)$$

11.4 Calculate the % water absorbed by volume as:

$$\% \text{by volume} = \% \text{water absorbed by weight} \times \rho / \rho_w \quad (2)$$

11.5 Calculate the percent water retained by weight as:

$$\% \text{water retained by weight} = 100 \times (W_3 - W_1) / W_1 \quad (3)$$

11.6 Calculate the % water retained by volume as:

$$\% \text{by volume} = \% \text{water retained by weight} \times \rho / \rho_w \quad (4)$$

11.6.1 The density of water shall be taken as 1 gm/cm³ (62.4 lb/ft³).

12. Report

12.1 Report the following information:

12.1.1 Description of material.

12.1.2 Specimen preparation method.

12.1.3 Width, length, and thickness of each specimen.

12.1.4 Conditioned density of each specimen.

12.1.5 Average and standard deviation of 12.1.4.

12.1.6 Percent water absorbed by weight and volume of each specimen to the nearest 0.1 %.

12.1.7 Average and standard deviation of 12.1.6.

12.1.8 Percent water retained by weight and volume of each specimen to the nearest 0.1 %.

12.1.9 Average and standard deviation of 12.1.8.