



Designation: ~~C272/C272M~~—16 C272/C272M – 18

Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions¹

This standard is issued under the fixed designation C272/C272M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the relative amount of water absorption by various types of sandwich construction core materials when immersed in water, or when subjected to a high relative humidity environment. Permissible core material forms include those with continuous bonding surfaces (such as balsa wood and foams) as well as those with discontinuous bonding surfaces (such as honeycomb).

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 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.

1.2.1 Within the text the inch-pound units are shown in brackets.

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

D883 Terminology Relating to Plastics

D1193 Specification for Reagent Water

D3878 Terminology for Composite Materials

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

3. Terminology

3.1 *Definitions*—Terminology D3878 defines terms relating to high-modulus fibers and their composites, as well as terms relating to sandwich constructions. Terminology D883 defines terms relating to plastics. Terminology E456 and Practice E177 define terms relating to statistics. In the event of a conflict between terms, Terminology D3878 shall have precedence over the other terminologies.

3.2 *Symbols:*

3.2.1 *CV*—coefficient of variation statistic of a sample population for a given property (in percent).

3.2.2 *D*—pre-immersion mass of a test specimen.

¹ This test method is under the jurisdiction of ASTM Committee D30 on Composite Materials and is the direct responsibility of Subcommittee D30.09 on Sandwich Construction.

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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.

- 3.2.3 h —height of a test specimen.
- 3.2.4 l —length of a test specimen.
- 3.2.5 S_{n-1} —standard deviation statistic of a sample population for a given property.
- 3.2.6 x_j —test result for an individual specimen from the sample population for a given property.
- 3.2.7 \bar{x} —mean or average (estimate of mean) of a sample population for a given property.
- 3.2.8 V —volume of a test specimen.
- 3.2.9 w —width of a test specimen.
- 3.2.10 W —mass of a test specimen.

4. Summary of Test Method

4.1 This test method consists of exposing sandwich core specimen to a defined moisture condition, and determining the amount of water absorbed by measuring the mass increase in the specimen.

5. Significance and Use

5.1 Absorbed water affects the characteristic properties of sandwich core materials, such as electrical properties (for example, dielectric constant, loss tangent, and electrical resistance) and mechanical properties (for example, strength and modulus). The mass of absorbed water may also affect the behavior of sandwich structures. It should be noted that in a sandwich panel the presence of facings bonded on two sides of the core may affect the amount of water absorbed by the core.

5.2 This test method provides a standard method of obtaining sandwich core moisture absorption data for design properties, material specifications, research and development applications, and quality assurance.

5.3 Factors that influence the water absorption and shall therefore be reported include the following: core material, methods of material fabrication, core geometry (honeycomb cell size, honeycomb cell wall thickness, foam pore size, etc.), specimen geometry, specimen preparation, methods of mass and dimensional measurement, specimen conditioning, and moisture content during mass and dimensional measurements.

6. Interferences

6.1 *Material and Specimen Preparation*—Poor material fabrication practices and damage induced by improper specimen machining are known causes of high data scatter in composites and sandwich structures in general. Important aspects of sandwich core specimen preparation that contribute to data scatter include the existence of joints, voids or other core discontinuities, out-of-plane curvature, and surface roughness. Cracks in the specimen and rough surfaces can increase the apparent water absorption.

6.2 *Surface Water*—Some core materials tend to collect water on the surfaces or trap water in corners, and, if not removed will give incorrect results.

6.3 *Environment*—Results are affected by the environmental conditions under which specimens are conditioned.

7. Apparatus

7.1 *Analytical Balance or Weighing Scale*—An analytical balance or weighing scale is required that is capable of measuring the sample weight accurately to ± 0.001 g/0.01 %.

7.2 *Oven:*

7.2.1 *Circulating Air Oven*—For Procedure A and C tests, an air-circulating oven is required that shall be capable of maintaining the required uniform temperatures to within $\pm 3^\circ\text{C}$ [$\pm 5^\circ\text{F}$].

7.2.2 *Circulating Air Vacuum Oven*—For Procedure B tests, an air-circulating oven is required that shall be capable of maintaining the required uniform temperatures to within $\pm 3^\circ\text{C}$ [$\pm 5^\circ\text{F}$], shall be capable of achieving full vacuum, and shall have a drying device on the air inlet line.

7.3 *Desiccator*—A clean, dry desiccator is required; specimens being oven-dried shall be brought to laboratory temperature following removal from the oven.

7.4 *Humidity Chamber*—A humidity chamber is required that shall be capable of maintaining uniform relative humidity with an accuracy of ± 5 % and a uniform temperature with an accuracy of $\pm 3^\circ\text{C}$ [$\pm 5^\circ\text{F}$].

7.5 The water used in this test method shall be distilled water (Specification D1193, Type IV reagent water) or deionized water.

8. Sampling and Test Specimens

8.1 Test at least five specimens per test condition unless valid results can be gained through the use of fewer specimens, such as in the case of a designed experiment. For statistically significant data, consult the procedures outlined in Practice E122. Report the method of sampling.