Designation: C272/C272M – 12

StandardTest Method for Water Absorption of Core Materials for Sandwich Constructions[1]

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 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C274 Terminology of Structural Sandwich Constructions
D883 Terminology Relating to Plastics
D1193 Specification for Reagent Water
D3878 Terminology for Composite Materials
D5229/D5229M Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix 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. Terminology C274 defines terms relating to structural 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.

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_1—test result for an individual specimen from the sample population for a given property.

3.2.7 *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

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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.

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 accurately to 0.001 g.

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 ±3°C [±5°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 ±3°C [±5°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 ±3°C [±5°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.

8.2 *Geometry*—Test specimens shall have a square or rectangular cross-section. The recommended specimen size is 75 mm [3.0 in.] in length by 75 mm [3.0 in.] in width by 13 mm [0.5 in.] in thickness.

NOTE 1—The specimen's cross-sectional area (length times width) is defined in the facing plane, in regard to the orientation that the core would be placed in a structural sandwich construction. For example, for a honeycomb core the cross-sectional area is defined in the plane of the cells, which is perpendicular to the orientation of the cell walls.

8.3 *Specimen Preparation and Machining*—Machine, saw, or shear the test specimens from the core sample so as to have smooth surfaces that are free from cracks and facing plane surfaces that are parallel to each other and perpendicular to the sides of the specimen. Record and report the specimen cutting preparation method.

8.4 *Labeling*—Label the test specimens so that they will be distinct from each other and traceable back to the sheet of origin, and will neither influence the test nor be affected by it.

9. Calibration

9.1 The accuracy of all measuring equipment shall have certified calibrations that are current at the time of use of the equipment.

10. Pre-Test Conditioning

10.1 Oven dry the specimens as follows:

10.1.1 For materials whose water absorption value would be affected by temperatures up to approximately 110°C [230°F], dry the specimens in an oven for 24 h at 50 ± 3°C [120 ± 5°F], cool in a desiccator to room temperature, remove, and immediately weigh and record the mass. After weighing, immediately place the specimens in the water or humidity chamber.

10.1.2 For materials whose water absorption value has been shown not to be affected by temperatures up to 110°C [230°F], dry the specimens in an oven for 2 h at 105 ± 3°C [225 ± 5°F], cool in a desiccator to room temperature, remove, and immediately weigh and record the mass. After weighing, immediately place the specimens in the water or humidity chamber.

10.1.3 For specimens to be conditioned using Procedure B below, dry the specimens per 10.1.1 or 10.1.2 in a vacuum drying oven without application of vacuum. After the time periods specified above, apply full vacuum for 30 min to remove remaining traces of moisture. When reducing the vacuum level, ambient venting air should be passed through a calcium sulfate desiccant or suitable alternate in-line trap.

10.2 In the case of a new material of which the water absorption properties are not known, conditioning separate