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Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions[1]

This standard is issued under the fixed designation C 272; 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] This test method is under the jurisdiction of ASTM Committee D-30 on Composite Materials and is the direct responsibility of Subcommittee D30.09 on Sandwich Construction.

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1. Scope

1.1 This test method covers the determination of the relative ~~rate~~ amount of water absorption by various types of structural core materials when immersed or in a high relative humidity environment. This test method is intended to apply to only structural core materials; honeycomb, foam, and balsa wood.

1.2 The values stated in ~~inch-pound~~ SI units are to be regarded as the standard. The ~~SI~~ inch-pound units given may be approximate.

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:*

C 271 Test Method for Density of Sandwich Core Materials[2]

C 274 Terminology of Structural Sandwich Constructions[2]

D 1193 Specification for Reagent Water[3]

3. ~~Significance and Use~~

~~3.1 The moisture content of most core materials is related~~ Terminology

3.1 *Definitions*—Terminology C 274 defines terms relating to ~~such properties as electrical properties (such as dielectric, loss tangent, electrical resistance) and mechanical properties (such as strength and modulus). Also important is the amount of weight the structure may gain by the core absorbing water. It should be noted that in a~~ sandwich ~~panel there are facings bonded on two sides of the core that effect the amount of water absorbed by the core.~~ constructions.

4. Summary of Test Method

4.1 A small piece of the core material is conditioned in various moisture conditions, and the amount of moisture absorbed is measured by the weight increase in the specimen.

5. Significance and Use

5.1 The moisture content of most core materials is related to such properties as electrical properties (such as dielectric constant, loss tangent, and electrical resistance) and mechanical properties (such as strength and modulus). The amount of weight the structure may gain by the core absorbing water is also important. It should be noted that in a sandwich panel there are facings bonded on two sides of the core that affect the amount of water absorbed by the core.

6. Interferences

6.1 *Material and Specimen Preparation*—Cracks in the specimen and rough surfaces can increase the apparent water absorption.

[2] *Annual Book of ASTM Standards*, Vol 15.03.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

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.

7. Apparatus

~~4~~7.1 *Analytical Balance*, capable of measurement to 0.001 g.

~~4~~7.2 *Circulating Air Oven*, capable of maintaining uniform temperatures with an accuracy of ~~±5°F (±3°C).~~

~~4.3~~ ±3°C (±5°F).

7.3 *Humidity Chamber*, capable of maintaining uniform relative humidity with an accuracy of ±5 % and a uniform temperature with an accuracy of ~~±5°F (±3°C).~~

~~4.4 The~~ ±3°C (±5°F).

7.4 The water used in this test method ~~should~~ shall be distilled water (Specification D 1193, Type IV reagent water) or deionized water.

5~~8~~. Sampling and Test Specimens

5~~8~~.1 T~~he~~st 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.

8.2 The test specimen shall be ~~3~~ 75 by ~~3~~ 75 by ~~0.5 in. thick (76.2 by 76.2 by~~ 12.7 mm (3 by 3 by 0.5 in.) thick~~)~~. The thickness of the specimen shall be in the same direction as the core thickness when used in a sandwich panel.

5~~8~~.~~2~~3 Machine, saw, or shear the test specimens from the core sample so as to have smooth surfaces that are free from cracks.

5~~8~~.~~3~~4 Measure the length and width dimensions to the nearest ~~0.01 in. (0.254 mm)~~ 0.25 mm (0.01 in.) and the thickness to the nearest ~~0.001 in. (0.0254 mm).~~

~~6.~~ 0.025 mm (0.001 in.).

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. Conditioning

~~6.1 Weigh five~~

10.1 Weigh the specimens individually and then oven dry as follows:

~~6~~10.1.1 For materials whose water absorption value would be affected by temperatures up to approximately ~~230°F (110°C),~~ 110°C (230°F), dry the specimens in an oven for 24 h at ~~120~~ 50° ± ~~5°F (49°~~ 3°C (120 ± ~~3°C),~~ 5°F), cool in a desiccator to room temperature, remove, and immediately weigh and record the weight.

~~6~~10.1.2 For materials whose water absorption value has been shown not to be affected by temperatures up to ~~230°F (110°C),~~ 110°C (230°F), dry the specimens in an oven for 2 h at ~~225~~ 105 ± ~~5°F (107~~ 3°C (225 ± ~~3°C),~~ 5°F), cool in a desiccator to room temperature, remove, and immediately weigh and record the weight.

~~6~~10.1.3 In the case of a new material of which the water absorption properties ~~of which~~ are not known, condition the specimens in accordance with ~~6~~ 10.1.1 and ~~6~~ 10.1.2 until sufficient experience on the effect of temperature is achieved to indicate the selection of the most satisfactory method.

~~7~~11. Procedure

~~7~~11.1 *Test Method A—Twenty-Four-Hour Immersion*—Completely immerse the specimens in a container of ~~73~~ 23 ± ~~5°F (23~~ 3°C (73 ± ~~3°C)~~ 5°F) water. Materials that float should be held under water by a loose net. At the end of 24 h, remove the specimens, shake vigorously, wipe off all surface water with a dry cloth, and immediately weigh and record the weight. For materials that tend to collect water on the surfaces or trap water in corners, dip the specimen in alcohol, shake vigorously, allow the alcohol to evaporate, and immediately weigh and record the weight.

~~7~~11.2 *Test Method B—Elevated Temperature Humidity*:

~~7~~11.2.1 The standard condition shall be ~~160~~ 70 ± ~~5°F (71~~ 3°C (160 ± ~~3°C)~~ 5°F) and 85 ± 5 % relative humidity for 30 days. However, other temperatures, relative humidities, and lengths of time can be used but must be reported.

~~7~~11.2.2 Place the specimens in the chamber with the ~~3~~ 75 by ~~3 in. (76.2~~ 75 mm (3 by ~~76.2 mm)~~ 3 in.) planes in the vertical position and the ends sitting on an open base (such as a screen or perforated material).

~~7~~11.2.3 The standard conditioned specimens should not have condensed water on their surfaces. Therefore, take the specimens out of the chamber, allow to cool to room temperature, and immediately weigh and record the weight.

~~7~~11.2.4 For specimens in conditions that cause condensation water to be on the specimen's surfaces, remove the specimens from the chamber, shake vigorously, wipe off all surface water with a dry cloth~~,~~ (if required), dip the specimen in alcohol, shake vigorously, allow the alcohol to evaporate, and immediately weigh and record the weight.

~~7~~11.3 *Test Method C—Maximum Percent Weight Gain*—Completely immerse the specimens in a container of water at a temperature of ~~73~~ 23 ± 3°C (73 ± 5°F). Materials that float should be held under water by a loose net. At the end of 48 h, remove the specimens one at a time, shake vigorously, wipe off all surface water with a dry cloth (if required), dip the specimens in alcohol,

shake vigorously, allow the alcohol to evaporate, and immediately weigh, and record the weight. Place the specimens back into the water and repeat this process until the weight gain after one 48-h interval is less than 2 % of the entire weight gain of all the previous intervals.

~~7~~11.4 *Surface Water Correction*—When surface water on the specimens presents a problem, determine the amount of surface water left on the specimens using the following procedure. Weigh five control samples, dip quickly in water, then follow the same procedure used on the actual specimens to determine the weight gain. Subtract the average surface water weight gain to correct the actual wet specimen weight.

~~8~~12. Calculation

~~8~~12.1 Calculate the percentage increase in weight as follows:

$$\text{Increase in weight, \%} = \frac{W - D}{D} \times 100 \quad (1)$$

where:

W = wet weight, and
D = dry weight.

~~8~~12.2 Calculate the specimen density in accordance with Test Method C 271.

~~9~~13. Report

~~9~~13.1 Report the following information:
~~9.~~13.~~1~~2 Description of core material tested,
~~9.~~13.~~2~~3 Product designation and batch number,
~~9.~~1.3.4 Method and conditions of test environment used,
~~9.~~13.~~4~~5 Individual specimen dimensions, weight, and density before conditioning,
~~9.~~13.~~5~~6 Individual specimen weight increase percentage~~;~~ (note if corrected for surface water), and
~~9.1.6 The average,~~
13.7 Average, standard deviation, and coefficient of variation of the weight increase percentage.

10~~4~~. Precision and Bias

~~10.1 Since there is no accepted reference material suitable~~
14.1 *Precision*—The data required for ~~determining~~ the development of a precision ~~and bias, no~~ statement is not available for this test method.
14.2 *Bias*—Bias can~~g~~not be determined for this test method as no accepted reference standard exists.

11~~5~~. Keywords

11~~5~~.1 moisture content; water absorption; water saturation