INTERNATIONAL

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Standard Test Methods for Void Content of Reinforced Plastics[1]

This standard is issued under the fixed designation D2734; 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 These test methods cover the void content of reinforced plastics or "composites." The test methods are applicable to composites for which the effects of ignition on the materials are known. Most plastics, glass, and reinforcements fall into this class. These test methods are not applicable to composites for which the effects of ignition on the plastics, the reinforcement, and any fillers are unknown. This class may include silicone resins, which do not burn off completely, reinforcements consisting of metals, organic materials, or inorganic materials which may gain or lose weight, and fillers consisting of oxides, carbonates, etc., which may gain or lose weight. Note that separate weight loss tests of individual materials will usually, but not necessarily, give the same result as when all the materials are combined.

NOTE 1—There is no known ISO equivalent to these test methods.

1.2 The values stated in SI units are to be regarded as standard.

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~~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]

D618 Practice for Conditioning Plastics for Testing
D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D883 Terminology Relating to Plastics
D1505 Test Method for Density of Plastics by the Density-Gradient Technique
D2584 Test Method for Ignition Loss of Cured Reinforced Resins
E456 Terminology Relating to Quality and Statistics

[1] These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and are the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

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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.

***A Summary of Changes section appears at the end of this standard**

3. Terminology

3.1 *Definitions*—Terms used in this standard are defined in accordance with Terminology D883, unless otherwise specified. For terms relating to precision and bias and associated issues, the terms used in this standard are defined in accordance with Terminology E456.

4. Summary of Test Methods

4.1 The densities of the resin, the reinforcement, and the composites are measured separately. Then the resin content is measured and a theoretical composite density calculated. This is compared to the measured composite density. The difference in densities indicates the void content. A good composite may have 1 % voids or less, while a poorly made composite can have a much higher void content. Finite values under 1 % should be recognized as representing a laminate density quality, but true void content level must be established by complementary tests or background experience, or both.

5. Significance and Use

5.1 The void content of a composite may significantly affect some of its mechanical properties. Higher void contents usually mean lower fatigue resistance, greater susceptibility to water penetration and weathering, and increased variation or scatter in strength properties. The knowledge of void content is desirable for estimation of quality of composites.

6. Interferences

6.1 The density of the resin, in these test methods, is assumed to be the same in the composite as it is in a large cast mass. Although there is no realistic way to avoid this assumption, it is nevertheless not strictly correct. Differences in curing, heat and pressure, and molecular forces from the reinforcement surface all change the composite resin density from the bulk resin density. The usual change is that bulk density is lower, making void content seem lower than it really is.

6.2 For composites with high void contents, this error will lower the true value an insignificant amount, from a true 7 % down to a calculated 6.7 %, for example. For composites with low and void contents, the value may be lowered from a true 0.2 % to a calculated − 0.1 %. This would indicate an obvious error, and illustrates that as the void content gets lower the constant error in resin density gets progressively more important. Note that these values are for example only, that different resin systems can give different errors, and that it is left to the individual tester to determine the accuracy of the calculated result in his particular measurement.

6.3 For the special case of semi-crystalline plastics, such as polyphenylene sulfide (PPS) and polyetheretherketone (PEEK), an interference due to the level of crystallinity present in the composite can cause significant variation in the measurement of void content by this test method. The level of crystallinity can be affected by a variety of circumstances, including the molding conditions. For these polymers, the density used in the calculation must be the actual density of the resin in the composite.

NOTE 2—The actual degree of crystallinity of the composite can be measured by techniques such as differential scanning calorimetry (DSC) or by X-ray diffraction.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be 1°C (1.8°F) and ±2 % relative humidity.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods. In cases of disagreement, the tolerances shall be 1°C (1.8°F) and ±5 % relative humidity.

8. Procedure

8.1 *Density of the Resin and the Composite*—Three test methods are presented for these measurements. Measure the density on pieces of resin that are bubble-free and that were cured under heat, time, and pressure conditions that are as close as practicable to the conditions under which the composite was cured. Density measurements supplied by the resin manufacturer are acceptable if they are certified for each batch.