Designation: D 3171 – 99

Standard Test Methods for Constituent Content of Composite Materials[1]

This standard is issued under the fixed designation D 3171; 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 These test methods determine the constituent content of composite materials by one of two approaches. Method I physically removes the matrix by digestion or ignition by one of seven procedures, leaving the reinforcement essentially unaffected and thus allowing calculation of reinforcement or matrix content (by weight or volume) as well as percent void volume. Method II, applicable only to laminate materials of known fiber areal weight, calculates reinforcement or matrix content (by weight or volume) based on the measured thickness of the laminate. Method II is not applicable to the measurement of void volume.

1.1.1 These test methods are primarily intended for two-part composite material systems. However, special provisions can be made to extend these test methods to filled material systems with more than two constituents, though not all test results can be determined in every case.

1.1.2 The procedures contained within have been designed to be particularly effective for certain classes of polymer or metal matrices. The suggested applications are discussed in Section 4, as well as at the start of each procedure.

1.1.3 Method I assumes that the reinforcement is essentially unaffected by the digestion or ignition medium. A procedure for correction of the results for minor changes in the reinforcement is included. Procedures A through F are based on chemical removal of the matrix while Procedure G removes the matrix by igniting the matrix in a furnace.

1.1.4 Method II assumes that the fiber areal weight of the reinforcement material form is known or controlled to an acceptable tolerance. The presence of voids is not measured. Eq 9 and 10 assume zero void content to perform the calculation.

1.2 The SI units shown are considered 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 practices and determine the applicability of regulatory limitations prior to use.* See Section 9 for additional information.

2. Referenced Documents

2.1 *ASTM Standards:*

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement[2]

D 883 Terminology Relating to Plastics[2]

D 1505 Test Method for Density of Plastics by the Density Gradient Technique[2]

D 3878 Terminology of High-Modulus Reinforcing Fibers and Their Composites[3]

D 5229/D 5229M Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials[3]

E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases[4]

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials[5]

E 177 Practice for Use of Terms Precision and Bias in ASTM Test Methods[6]

E 1309 Guide for the Identification of Composite Materials in Computerized Material Property Databases[3]

3. Terminology

3.1 *Definitions*—Terminology D 3878 defines terms relating to composite materials. Terminology D 883 defines terms relating to plastics. Terminology E 12 defines terms relating to specific gravity. Practice E 177 defines terms relating to statistics. In the event of a conflict between terms, Terminology D 3878 shall have precedence over other documents.

3.1.1 *fiber content, n*—the amount of fiber present in a composite or prepreg expressed either as percent by weight or percent by volume. This is sometimes stated as a fraction. If no fillers exist, this is equivalent to reinforcement content. **D 3878**

3.1.2 *matrix content, n*—the amount of matrix present in a composite or prepreg expressed either as percent by weight or percent by volume. For polymer matrix composites this is resin content. **D 3878**

3.1.3 *reinforcement content, n*—the amount of nonmatrix material (fiber and filler) in a composite or prepreg expressed

[1] These test methods are under the jurisdiction of ASTM Committee D-30 on Composite Materials and is the direct responsibility of Subcommittee D30.03 on Constituent/Precursor Properties.

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

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

[4] Discontinued; see *1995 Annual Book of ASTM Standards*, Vol 15.05. Replaced by Terminology E 1547.

[5] *Annual Book of ASTM Standards*, Vol 15.09.

[6] *Annual Book of ASTM Standards*, Vol 14.02.