



Designation: D3171 – 22

Standard Test Methods for Constituent Content of Composite Materials¹

This standard is issued under the fixed designation D3171; 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 determine the constituent content of composite materials by one of two approaches. Test Method I physically removes the matrix by digestion or ignition or carbonization by one of eight 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. Test Method II, applicable only to laminate materials of known fiber areal weight, calculates reinforcement or matrix content (by weight or volume), and the cured ply thickness, based on the measured thickness of the laminate. Test 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 Test Method I assumes that the reinforcement is essentially unaffected by the digestion or ignition medium or carbonization. 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. Procedure H carbonizes the matrix in a furnace.

1.1.4 Test 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 15 and 16 assume zero void content to perform the calculation.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* See Section 9 for additional information.

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

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

D3878 Terminology for Composite Materials

D5229/D5229M Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials

E12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases (Withdrawn 1996)³

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

3. Terminology

3.1 *Definitions*—Terminology D3878 defines terms relating to composite materials. Terminology D883 defines terms relating to plastics. Terminology E12 defines terms relating to

¹ These test methods are under the jurisdiction of ASTM Committee D30 on Composite Materials and are the direct responsibility of Subcommittee D30.04 on Lamina and Laminate Test Methods.

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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 The last approved version of this historical standard is referenced on www.astm.org.