Designation: C 1557 – 03$^{\epsilon 1}$

Standard Test Method for Tensile Strength and Young's Modulus of Fibers[1]

This standard is issued under the fixed designation C 1557; 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.

ϵ[1] NOTE—Fig. 3 was editorially corrected in June 2004.

1. Scope

1.1 This test method covers the preparation, mounting, and testing of single fibers (obtained either from a fiber bundle or a spool) for the determination of tensile strength and Young's modulus at ambient temperature. Advanced ceramic, glass, carbon and other fibers are covered by this test standard.

1.2 *This standard may involve hazardous materials, operations, and equipment. 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]

C 1239 Practice for Reporting Uniaxial Strength Data and Estimating Weibull Distribution Parameters for Advanced Ceramics

D 3878 Terminology of High-Modulus Reinforcing Fibers and their Composites

E 4 Practices for Load Verification of Testing Machines

E 6 Terminology Relating to Methods of Mechanical Testing

E 1382 Test Methods for Determining Average Grain Size Using Semiautomatic and Automatic Image Analysis

3. Terminology

3.1 *Definitions:*

3.1.1 *bundle*—a collection of parallel fibers. Synonym, *tow*.

3.1.2 *mounting tab*—a thin paper, cardboard, compliant metal, or plastic strip with a center hole or longitudinal slot of fixed gage length. The mounting tab should be appropriately designed to be self-aligning if possible, and as thin as practicable to minimize fiber misalignment.

3.1.3 *system compliance*—the contribution by the load train system and specimen-gripping system to the indicated cross-head displacement, by unit of force exerted in the load train.

3.2 For definitions of other terms used in this test method, refer to Terminologies D 3878 and E 6.

4. Summary of Test Method

4.1 A fiber is extracted randomly from a bundle or from a spool.

4.2 The fiber is mounted in the testing machine, and then stressed to failure at a constant cross-head displacement rate.

4.3 A valid test result is considered to be one in which fiber failure doesn't occur in the gripping region.

4.4 Tensile strength is calculated from the ratio of the peak force and the cross-sectional area of a plane perpendicular to the fiber axis, at the fracture location or in the vicinity of the fracture location, while Young's modulus is determined from the linear region of the tensile stress versus tensile strain curve.

5. Significance and Use

5.1 Properties determined by this test method are useful in the evaluation of new fibers at the research and development levels. Fibers with diameters up to 250×10^{-6} m are covered by this test method. Very short fibers (including whiskers) call for specialized test techniques **(1)**[3] and are not covered by this test method. This test method may also be useful in the initial screening of candidate fibers for applications in polymer, metal or ceramic matrix composites, and quality control purposes. Because of their nature, ceramic fibers do not have a unique strength, but rather, a distribution of strengths. In most cases when the strength of the fibers is controlled by one population of flaws, the distribution of fiber strengths can be described using a two-parameter Weibull distribution, although other distributions have also been suggested **(2,3)**. This test method constitutes a methodology to obtain the strength of a single fiber. For the purpose of determining the parameters of the distribution of fiber strengths it is recommended to follow this test method in conjunction with Practice C 1239.

[1] This test method is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.07 on Ceramic Matrix Composites .

Current edition approved April 10, 2003. Published August 2003.

[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 boldface numbers in parentheses refer to the list of references at the end of this standard.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.