Designation: C 1359 – 96 (Reapproved 2000)

Standard Test Method for Monotonic Tensile Strength Testing of Continuous Fiber-Reinforced Advanced Ceramics With Solid Rectangular Cross-Section Specimens at Elevated Temperatures[1]

This standard is issued under the fixed designation C 1359; 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 This test method covers the determination of tensile strength including stress-strain behavior under monotonic uniaxial loading of continuous fiber-reinforced advanced ceramics at elevated temperatures. This test method addresses, but is not restricted to, various suggested test specimen geometries as listed in the appendix. In addition, specimen fabrication methods, testing modes (load, displacement, or strain control), testing rates (load rate, stress rate, displacement rate, or strain rate), allowable bending, temperature control, temperature gradients, and data collection and reporting procedures are addressed. Tensile strength as used in this test method refers to the tensile strength obtained under monotonic uniaxial loading where monotonic refers to a continuous nonstop test rate with no reversals from test initiation to final fracture.

1.2 This test method applies primarily to advanced ceramic matrix composites with continuous fiber reinforcement: unidirectional (1-D), bi-directional (2-D), and tri-directional (3-D) or other multi-directional reinforcements. In addition, this test method may also be used with glass (amorphous) matrix composites with 1-D, 2-D, 3-D and other multi-directional continuous fiber reinforcements. This test method does not directly address discontinuous fiber-reinforced, whisker-reinforced, or particulate-reinforced ceramics, although the test methods detailed here may be equally applicable to these composites.

1.3 The values stated in SI units are to be regarded as the standard and are in accordance with Practice E 380.

1.4 *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.* Refer to Section 7 for specific precautions.

2. Referenced Documents

2.1 *ASTM Standards:*

C 1145 Terminology of Advanced Ceramics[2]

D 3379 Test Method for Tensile Strength and Young's Modulus for High-Modulus Single-Filament Materials[3]

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

E 4 Practices for Force Verification of Testing Machines[4]

E 6 Terminology Relating to Methods of Mechanical Testing[4]

E 21 Practice for Elevated Temperature Tension Tests of Metallic Materials[4]

E 83 Practice for Verification and Classification of Extensometers[4]

E 220 Test Method for Calibration of Thermocouples by Comparison Techniques[5]

E 337 Test Method for Measuring Humidity with Psychrometer (the Measurement of Wet-and Dry-Bulb Temperatures)[6]

E 380 Practice for Use of International System of Units (SI) (the Modernized Metric System)[7]

E 1012 Practice for Verification of Specimen Alignment Under Tensile Loading[4]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of terms relating to tensile testing, advanced ceramics, fiber-reinforced composites as they appear in Terminology E 6, Terminology C 1145, and Terminology D 3878, respectively, apply to the terms used in this test method. Pertinent definitions are shown in the following with the appropriate source given in parentheses. Additional terms used in conjunction with this test method are defined in 3.2.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *advanced ceramic*, *n*—a highly engineered, high-performance predominately nonmetallic, inorganic, ceramic material having specific functional attributes. (See Terminology C 1145.)

3.2.2 *axial strain* $[LL^{-1}]$, *n*—the average longitudinal

[1] This test method is under the jurisdiction of ASTM Committee C-28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.07 on Ceramic Matrix Composites.

Current edition approved Dec. 10, 1996. Published December 1997.

[2] *Annual Book of ASTM Standards*, Vol 15.01.
[3] *Annual Book of ASTM Standards*, Vol 15.03.
[4] *Annual Book of ASTM Standards*, Vol 03.01.
[5] *Annual Book of ASTM Standards*, Vol 14.03.
[6] *Annual Book of ASTM Standards*, Vol 11.03.
[7] *Annual Book of ASTM Standards*, Vol 14.02.

This document is now POOBLIC

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