



Standard Test Method for Creep and Creep Rupture of Continuous Fiber-Reinforced Ceramic Composites under Tensile Loading at Elevated Temperatures¹

This standard is issued under the fixed designation C 1337; 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 the time-dependent deformation and time-to-rupture of continuous fiber-reinforced ceramic composites under constant tensile loading at elevated temperatures. This test method addresses, but is not restricted to, various suggested test specimen geometries. In addition, specimen fabrication methods, allowable bending, temperature measurements, temperature control, data collection, and reporting procedures are addressed.

1.2 This test method is intended primarily for use with all advanced ceramic matrix composites with continuous fiber reinforcement: unidirectional (1-D), bidirectional (2-D), and tridirectional (3-D). In addition, this test method may also be used with glass matrix composites with 1-D, 2-D, and 3-D continuous fiber reinforcement. This test method does not address directly discontinuous fiber-reinforced, whisker-reinforced, or particulate-reinforced ceramics, although the test methods detailed here may be equally applicable to these composites.

1.3 Values expressed in this test method are in accordance with the International System of Units (SI) and 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.* Hazard statements are noted in 7.1 and 7.2.

2. Referenced Documents

2.1 ASTM Standards:

C 1145 Terminology on Advanced Ceramics²

C 1275 Test Method for Monotonic Tensile Strength Testing of Continuous Fiber-Reinforced Advanced Ceramics with Solid Rectangular Cross-Section Specimens at Ambient Temperatures²

D 3878 Terminology of High-Modulus Reinforcing Fibers

and Their Composites³

E 4 Practices for Force Verification of Testing Machines⁴

E 6 Terminology Relating to Methods of Mechanical Testing⁴

E 83 Practice for Verification and Classification of Extensometers⁴

E 139 Practice for Conducting Creep, Creep Rupture, and Stress Rupture Tests of Metallic Materials⁴

E 220 Method for Calibration of Thermocouples by Comparison Techniques⁵

E 230 Specification for Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples⁶

E 337 Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet- and Dry-Bulb Temperatures)⁷

E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)⁸

E 1012 Practice for Verification of Specimen Alignment under Tensile Loading⁴

3. Terminology

3.1 *Definitions*—The definitions of terms relating to tensile testing appearing in Terminology E 6 apply to the terms used in this test method. The definitions relating to advanced ceramics appearing in Terminology C 1145 apply to the terms used in this test method. The definitions of terms relating to fiber reinforced composites appearing in Terminology D 3878 apply to the terms used in this test method. Additional terms used in conjunction with this test method are defined in the following:

3.1.1 *continuous fiber-reinforced ceramic matrix composite (CFCC)*—a ceramic matrix composite in which the reinforcing phase consists of a continuous fiber, continuous yarn, or a woven fabric.

3.1.2 *fracture strength*—the tensile stress which the material sustains at the instant of fracture. Fracture strength is

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.

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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 Discontinued; see 1994 *Annual Book of ASTM Standards*, Vol 14.03.

⁶ *Annual Book of ASTM Standards*, Vol 14.03.

⁷ *Annual Book of ASTM Standards*, Vol 11.03.

⁸ *Annual Book of ASTM Standards*, Vol 14.02.

