



Standard Test Method for Determination of Slow Crack Growth Parameters of Advanced Ceramics by Constant Stress Flexural Testing (Stress Rupture) at Elevated Temperatures¹

This standard is issued under the fixed designation C1834; 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 slow crack growth (SCG) parameters of advanced ceramics in a given test environment at elevated temperatures in which the time-to-failure of four-point- $\frac{1}{4}$ point flexural test specimens (see Fig. 1) is determined as a function of different levels of constant applied stress. This SCG constant stress test procedure is also called a slow crack growth (SCG) stress rupture test. The test method addresses the test equipment, test specimen fabrication, test stress levels and experimental procedures, data collection and analysis, and reporting requirements.

1.2 In this test method the decrease in time-to-failure with increasing levels of applied stress in specified test conditions and temperatures is measured and used to analyze the slow crack growth parameters of the ceramic. The preferred analysis method is based on a power law relationship between crack velocity and applied stress intensity; alternative analysis approaches are also discussed for situations where the power law relationship is not applicable.

NOTE 1—This test method is historically referred to in earlier technical literature as static fatigue testing (Refs 1-3)² in which the term fatigue is used interchangeably with the term *slow crack growth*. To avoid possible confusion with the fatigue phenomenon of a material that occurs exclusively under cyclic stress loading, as defined in E1823, this test method uses the term *constant stress testing* rather than static fatigue testing.

1.3 This test method uses a 4-point- $\frac{1}{4}$ point flexural test mode and applies primarily to monolithic advanced ceramics that are macroscopically homogeneous and isotropic. This test method may also be applied to certain whisker- or particle-reinforced ceramics as well as certain discontinuous fiber-reinforced composite ceramics that exhibit macroscopically homogeneous behavior. Generally, continuous fiber ceramic composites do not exhibit macroscopically isotropic,

homogeneous, elastic continuous behavior, and the application of this test method to these materials is not recommended.

1.4 This test method is intended for use at elevated temperatures with various test environments such as air, vacuum, inert gas, and steam. This test method is similar to Test Method C1576 with the addition of provisions for testing at elevated temperatures to establish the effects of those temperatures on slow crack growth. The elevated temperature testing provisions are derived from Test Methods C1211 and C1465.

1.5 Creep deformation at elevated temperatures can occur in some ceramics as a competitive mechanism with slow crack growth. Those creep effects may interact and interfere with the slow crack growth effects (see 5.5). This test method is intended to be used primarily for ceramic test specimens with negligible creep. This test method imposes specific upper-bound limits on measured maximum creep strain at fracture or run-out (no more than 0.1 %, in accordance with 5.5).

1.6 The values stated in SI units are to be regarded as the standard and in accordance with IEEE/ASTM SI 10.

1.7 *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:³

- C1145 Terminology of Advanced Ceramics
- C1161 Test Method for Flexural Strength of Advanced Ceramics at Ambient Temperature
- C1211 Test Method for Flexural Strength of Advanced Ceramics at Elevated Temperatures
- C1239 Practice for Reporting Uniaxial Strength Data and Estimating Weibull Distribution Parameters for Advanced Ceramics

¹ This test method is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.01 on Mechanical Properties and Performance.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.