



# Standard Test Method for Flexural Strength of Advanced Ceramics at Elevated Temperatures<sup>1</sup>

This standard is issued under the fixed designation C1211; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers determination of the flexural strength of advanced ceramics at elevated temperatures.<sup>2</sup> Four-point- $\frac{1}{4}$  point and three-point loadings with prescribed spans are the standard as shown in Fig. 1. Rectangular specimens of prescribed cross-section are used with specified features in prescribed specimen-fixture combinations. Test specimens may be 3 by 4 by 45 to 50 mm in size that are tested on 40 mm outer span four-point or three-point fixtures. Alternatively, test specimens and fixture spans half or twice these sizes may be used. The test method permits testing of machined or as-fired test specimens. Several options for machining preparation are included: application matched machining, customary procedures, or a specified standard procedure. This test method describes the apparatus, specimen requirements, test procedure, calculations, and reporting requirements. The test method is applicable to monolithic or particulate- or whisker-reinforced ceramics. It may also be used for glasses. It is not applicable to continuous fiber-reinforced ceramic composites.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

<sup>1</sup> 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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<sup>2</sup> Elevated temperatures typically denote, but are not restricted to 200 to 1600°C.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

C1161 Test Method for Flexural Strength of Advanced Ceramics at Ambient Temperature  
C1239 Practice for Reporting Uniaxial Strength Data and Estimating Weibull Distribution Parameters for Advanced Ceramics  
C1322 Practice for Fractography and Characterization of Fracture Origins in Advanced Ceramics  
C1341 Test Method for Flexural Properties of Continuous Fiber-Reinforced Advanced Ceramic Composites  
C1368 Test Method for Determination of Slow Crack Growth Parameters of Advanced Ceramics by Constant Stress-Rate Strength Testing at Ambient Temperature  
C1465 Test Method for Determination of Slow Crack Growth Parameters of Advanced Ceramics by Constant Stress-Rate Flexural Testing at Elevated Temperatures  
E4 Practices for Force Verification of Testing Machines  
E220 Test Method for Calibration of Thermocouples By Comparison Techniques  
E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples

## 3. Terminology

### 3.1 Definitions:

3.1.1 *complete gage section, n*—the portion of the specimen between the two outer bearings in four-point flexure and three-point flexure fixtures.

NOTE 1—In this standard, the complete four-point flexure gage section is twice the size of the inner gage section. Weibull statistical analyses, in this instance, only include portions of the specimen volume or surface which experience tensile stresses.

3.1.2 *flexural strength*—a measure of the ultimate strength of a specified beam in bending.

3.1.3 *four-point-1/4 point flexure*—a configuration of flexural strength testing in which a specimen is symmetrically loaded at two locations that are situated at one-quarter of the overall span, away from the outer two support bearings (see Fig. 1).

3.1.4 *fully-articulating fixture, n*—a flexure fixture designed to be used either with flat and parallel specimens or with uneven or nonparallel specimens. The fixture allows full independent articulation, or pivoting, of all rollers about the specimen long axis to match the specimen surface. In addition,

\*A Summary of Changes section appears at the end of this standard