Designation: C1684 – 18 (Reapproved 2023)

Standard Test Method for Flexural Strength of Advanced Ceramics at Ambient Temperature—Cylindrical Rod Strength[1]

This standard is issued under the fixed designation C1684; 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 is for the determination of flexural strength of rod-shaped specimens of advanced ceramic materials at ambient temperature. In many instances it is preferable to test round specimens rather than rectangular bend specimens, especially if the material is fabricated in rod form. This method permits testing of machined, drawn, or as-fired rod-shaped specimens. It allows some latitude in the rod sizes and cross section shape uniformity. Rod diameters between 1.5 and 8 mm and lengths from 25 to 85 mm are recommended, but other sizes are permitted. Four-point-¼-point as shown in Fig. 1 is the preferred testing configuration. Three-point loading is permitted. This method describes the apparatus, specimen requirements, test procedure, calculations, and reporting requirements. The 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C158 Test Methods for Strength of Glass by Flexure (Determination of Modulus of Rupture)

C1145 Terminology of Advanced Ceramics

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

C1368 Test Method for Determination of Slow Crack Growth Parameters of Advanced Ceramics by Constant Stress Rate Strength Testing at Ambient Temperature

E4 Practices for Force Calibration and Verification of Testing Machines

E337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)

3. Terminology

3.1 *Definitions:*

3.1.1 *complete gage section, n*—the portion of the specimen between the two outer loading points in four-point flexure and three-point flexure fixtures. **C1161**

3.1.2 *flaw, n*—a structural discontinuity in an advanced ceramic body that acts as a highly localized stress raiser.

3.1.2.1 *Discussion*—The presence of such discontinuities does not necessarily imply that the ceramic has been prepared improperly or is faulty. **C1322**

3.1.3 *flexural strength, [FL^{-2}], n*—a measure of the ultimate strength of a specified beam in bending. **C1145, C1161**

3.1.4 *four-point-¼-point flexure, n*—configuration of flexural strength testing where a specimen is symmetrically loaded

[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] 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.

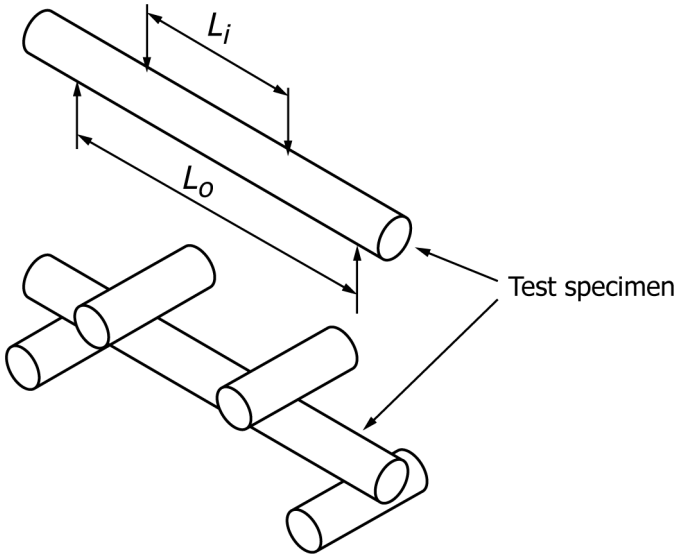

FIG. 1 Four-Point-¼-Point Flexure Loading Configuration

at two locations that are situated one-quarter of the overall span away from the outer two support loading points (see Fig. 1). **C1145, C1161**

3.1.5 *fracture origin, n*—the source from which brittle fracture commences. **C1145, C1322**

3.1.6 *inert flexural strength, [FL^{-2}], n*—a measure of the strength of specified beam in bending as determined in an appropriate inert condition whereby no slow crack growth occurs.

3.1.6.1 *Discussion*—An inert condition may be obtained by using vacuum, low temperatures, very fast test rates, or any inert media. **C1161**

3.1.7 *inherent flexural strength, [FL^{-2}], n*—the flexural strength of a material in the absence of any effect of surface grinding or other surface finishing process, or of extraneous damage that may be present. The measured inherent strength is in general a function of the flexure test method, test conditions, and test specimen size. **C1161**

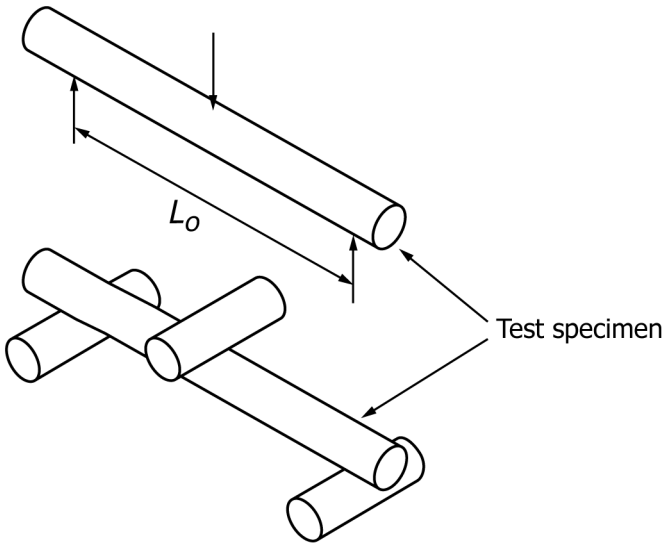

FIG. 2 Three-Point Flexure Loading Configuration