



Designation: C1469 – 00 (Reapproved 2005)

Standard Test Method for Shear Strength of Joints of Advanced Ceramics at Ambient Temperature¹

This standard is issued under the fixed designation C1469; 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 shear strength of joints in advanced ceramics at ambient temperature. Test specimen geometries, test specimen fabrication methods, testing modes (that is, force or displacement control), testing rates (that is, force or displacement rate), data collection, and reporting procedures are addressed.

1.2 This test method is used to measure shear strength of ceramic joints in test specimens extracted from larger joined pieces by machining. Test specimens fabricated in this way are not expected to warp due to the relaxation of residual stresses but are expected to be much straighter and more uniform dimensionally than butt-jointed test specimens prepared by joining two halves, which are not recommended. In addition, this test method is intended for joints, which have either low or intermediate strengths with respect to the substrate material to be joined. Joints with high strengths should not be tested by this test method because of the high probability of invalid tests resulting from fractures initiating at the reaction points rather than in the joint. Determination of the shear strength of joints using this test method is appropriate particularly for advanced ceramic matrix composite materials but also may be useful for monolithic advanced ceramic materials.

1.3 Values expressed in this test method are in accordance with the International System of Units (SI) and Practice [IEEE/ASTM SI 10](#).

1.4 *This test method does not purport to address the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are noted in [8.1](#) and [8.2](#).

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

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2. Referenced Documents

2.1 ASTM Standards:²

- [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](#)
- [C1275 Test Method for Monotonic Tensile Behavior of Continuous Fiber-Reinforced Advanced Ceramics with Solid Rectangular Cross-Section Test Specimens at Ambient Temperature](#)
- [C1341 Test Method for Flexural Properties of Continuous Fiber-Reinforced Advanced Ceramic Composites](#)
- [D3878 Terminology for Composite Materials](#)
- [D5379/D5379M Test Method for Shear Properties of Composite Materials by the V-Notched Beam Method](#)
- [E4 Practices for Force Verification of Testing Machines](#)
- [E6 Terminology Relating to Methods of Mechanical Testing](#)
- [E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process](#)
- [E337 Test Method for Measuring Humidity with a Psychrometer \(the Measurement of Wet- and Dry-Bulb Temperatures\)](#)
- [IEEE/ASTM SI 10 American National Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

3. Terminology

3.1 *Definitions*—The definitions of terms relating to shear strength testing appearing in Terminology [E6](#), to advanced ceramics appearing in Terminologies [C1145](#) and [D3878](#) apply to the terms used in this test method. Additional terms used in conjunction with this test method are defined as follows.

3.1.1 *advanced ceramic, n*—highly-engineered, high-performance predominately nonmetallic, inorganic, ceramic material having specific functional attributes. **C1145**

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.

3.1.2 *breaking force* [F], n —force at which fracture occurs.

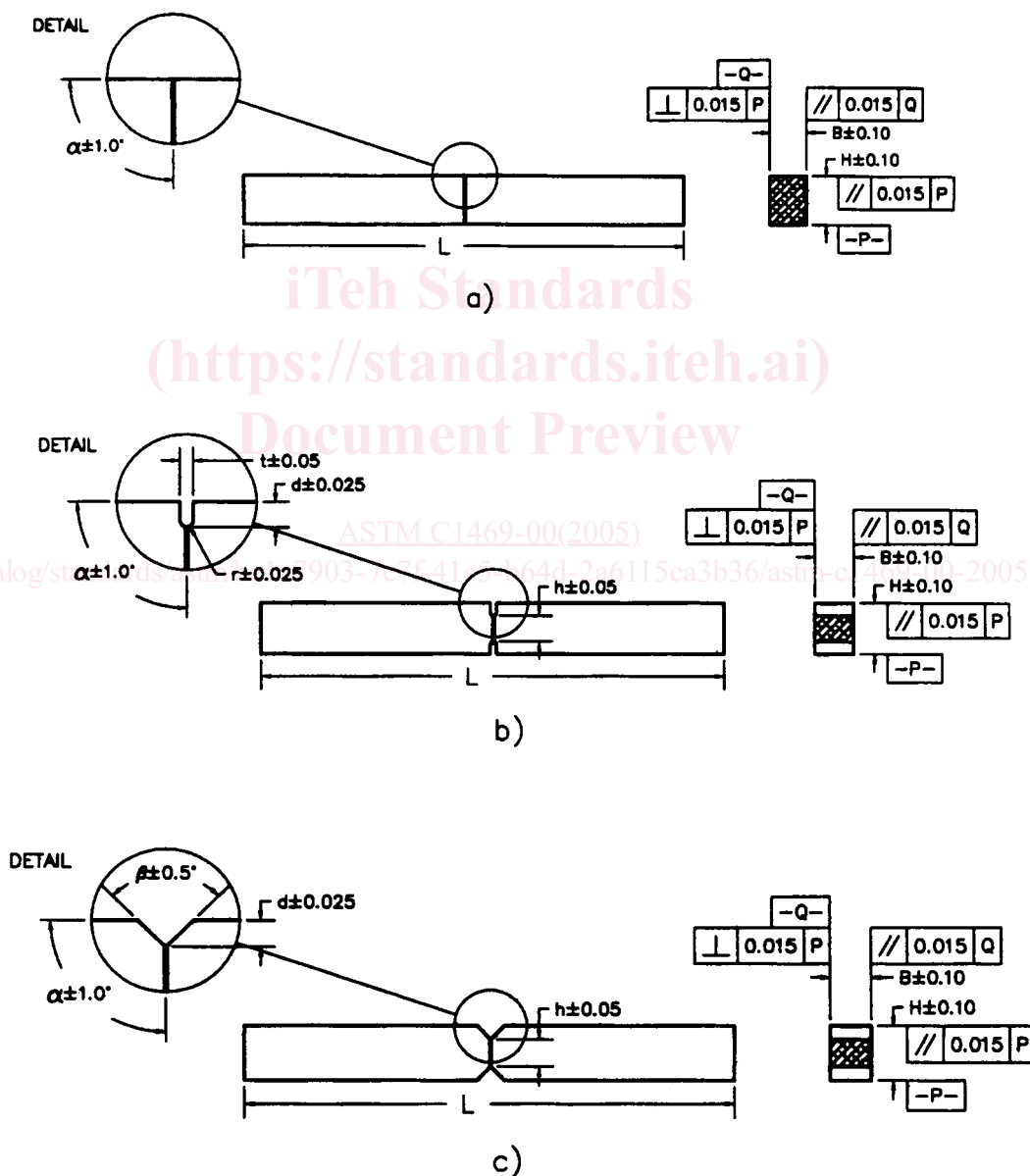
3.1.3 *ceramic matrix composite*, n —material consisting of two or more materials (insoluble in one another), in which the major, continuous component (matrix component) is a ceramic while the secondary component(s) may be ceramic, glass-ceramic, glass, metal, or organic in nature. These components are combined on macroscale to form a useful engineering material possessing certain properties or behavior not possessed by the individual constituents. **C1275**

3.1.4 *joining*, n —controlled formation of chemical, or mechanical bond, or both, between similar or dissimilar materials.

3.1.5 *shear strength* [F/L^2], n —maximum shear stress which a material is capable of sustaining. Shear strength is calculated from the shear fracture force and the shear stressed area.

4. Summary of Test Method

4.1 This test method describes an asymmetrical four-point flexure test method to determine shear strengths of advanced ceramic joints. Test specimens and test setup are shown schematically in Fig. 1 and Fig. 2, respectively. Selection of the test specimen geometry depends on the bond strength of the joint, which may be determined by preparing longer test specimens of the same cross-section and using a standard four-point flexural strength test, for example, Test Method C1161 for monolithic advanced ceramic base material and Test Method C1341 for composite advanced ceramic base material. If the joint flexural strength is low (that is, <25 % of the flexural strength of the base material), the recommended test specimen geometry for shear strength testing of the joint is the



NOTE 1—The width of the joint, which varies between 0.05 and 0.20 mm, based on the joining method used, is smaller than that of the notch in b). All dimensions are given in mm.

FIG. 1 Schematics of Test Specimen Geometries: a) Uniform, b) Straight-Notched and c) V-Notched