Designation: C1469 – 22

Standard Test Method for Shear Strength of Joints of Advanced Ceramics at Ambient Temperature[1]

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 using asymmetrical four-point flexure. 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 is 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 IEEE/ASTM SI 10.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are noted in 8.1.

1.5 *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]

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 Calibration and 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 Metric Practice

3. Terminology

3.1 *Definitions:*

3.1.1 The definitions of terms relating to shear strength testing appearing in Terminology E6 and to advanced ceramics appearing in Terminologies C1145 and D3878 apply to the

[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] 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.

terms used in this test method. Additional terms used in conjunction with this test method are defined as follows.

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

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

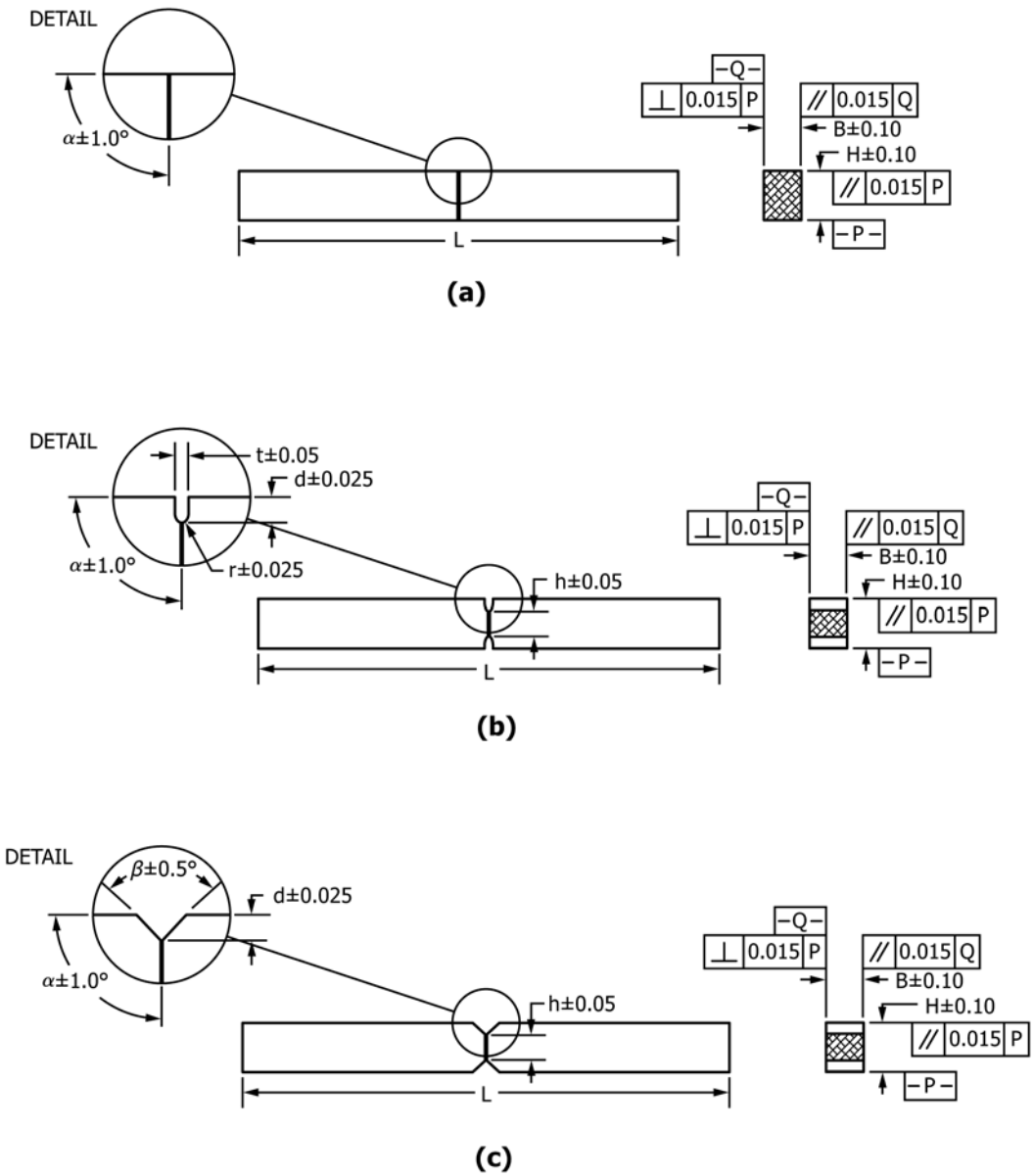
3.1.4 *ceramic matrix composite, n*—material consisting of two or more materials (insoluble in one another) in which the major, continuous component (matrix component) is a ceramic while the secondary component(s) may be ceramic, glass-ceramic, glass, metal, or organic in nature. These components are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

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

3.1.6 *shear strength [F/L^2], n*—maximum shear stress that a material is capable of sustaining. Shear strength is calculated from breaking force in shear and shear 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



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