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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for flexural strength of monolithic ceramics at room temperature

Céramiques techniques — Méthode d'essai de résistance en flexion des céramiques monolithiques à température ambiante

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 206, *Fine ceramics*.

This third edition cancels and replaces the second edition (ISO 14704:2008), which has been technically revised.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for flexural strength of monolithic ceramics at room temperature

1 Scope

This International Standard specifies a test method for determining the flexural strength of monolithic fine ceramics, and whisker- or particulate-reinforced ceramic composites, at room temperature and applies to materials with grain size less than 200 μm. This test method may be used for materials development, quality control, characterization and design data-generation purposes.

NOTE Since fracture is due to tensile stress, flexural strength data can be used to calculate a uniaxial tensile strength considering the effect of the tested volume and Weibull-statistics. So, flexural strength is often used in substitute for uniaxial tensile strength.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

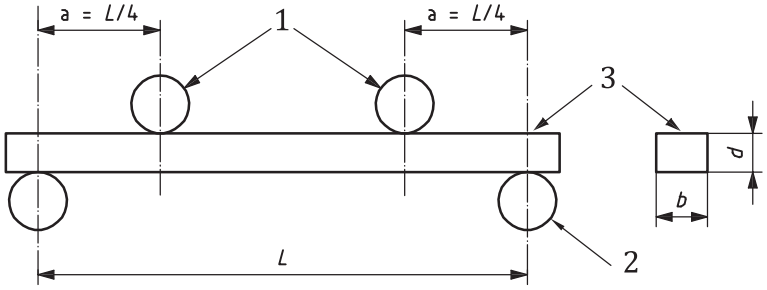
3.1
flexural strength
maximum nominal stress at fracture of a specified elastic beam loaded in bending

3.2
four-point flexure
configuration of flexural strength testing where a test piece is loaded equally by two bearings symmetrically located between two support bearings

Note 1 to entry: See Figure 1, a) and b).

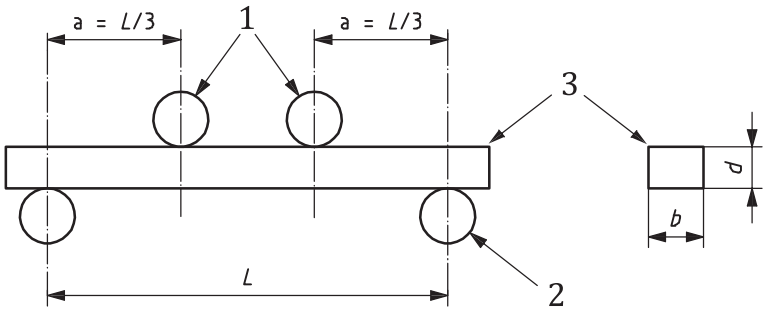
Note 2 to entry: The bearings may be cylindrical rollers or cylindrical bearings.

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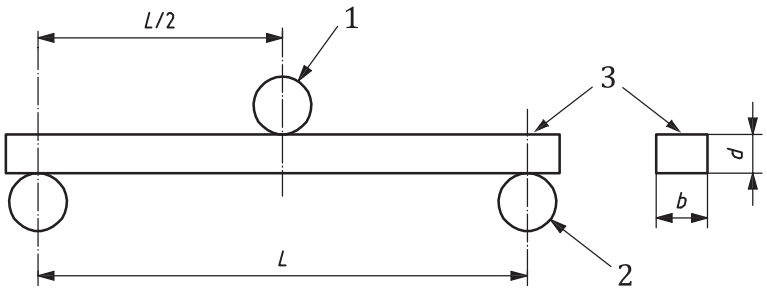
L = 40 mm ± 0,1 mm

a) Four-point-1/4 point flexure



L = 30 mm ± 0,1 mm

b) Four-point-1/3 point flexure



L = 30 mm ± 0,1 mm or 40 mm ± 0,1 mm

c) Three-point flexure

Key

1 loading bearings
2 support bearing
3 test piece

Figure 1 — Flexural test configurations

3.3
four-point-1/4 point flexure
specific configuration of four-point flexural strength testing where the inner bearings are situated one-quarter of the support span away from the two outer bearings

Note 1 to entry: See Figure 1 a).

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3.4
four-point-1/3 point flexure
specific configuration of four-point flexural strength testing where the inner bearings are situated one-third of the support span away from the two outer bearings

Note 1 to entry: See Figure 1 b).

3.5
semi-articulating fixture
test fixture designed to apply uniform and even loading to test pieces that have flat and parallel surfaces

3.6
fully articulating fixture
test fixture designed to apply uniform and even loading to test pieces that may have uneven, non-parallel or twisted surfaces

3.7
three-point flexure
configuration of flexural strength testing where a test piece is loaded at a location midway between two support bearings

Note 1 to entry: See Figure 1 c).

Note 2 to entry: *Four-point flexure* (3.2) is usually preferred, since a large amount of material is exposed to the maximum stress (see Annex A for more information).

4 Principle

A beam test piece with a rectangular cross-section is loaded in flexure until fracture. The load at fracture, the test fixture and test piece dimensions are used to compute the flexural strength which is often used in substitute for uniaxial tensile strength of a ceramic. The material is assumed to be isotropic and linearly elastic.

5 Apparatus

5.1 Testing machine

The testing machine shall be capable of applying a force to the loading roller (three-point flexure) or equally to the loading rollers (four-point flexure) in order to stress the test piece. The machine shall be capable of applying the force at a constant loading or displacement rate. The test machine shall be equipped for recording the peak load applied to the test piece. The accuracy of the test machine shall be in accordance with ISO 7500-1, Class 1, with an accuracy of 1 % of indicated load at fracture.

5.2 Test fixture

5.2.1 General

Three- or four-point flexure configurations shall be used, as illustrated in Figure 1. The four-point-1/4 point configuration is recommended. The fixture shall have bearings that are free to roll, as described in 5.2.2, in order to eliminate frictional constraints when the test piece surfaces expand or contract during loading. In addition, the fixture shall be designed so that parts "articulate" or tilt to ensure uniform loading to the test piece. The articulation is designed so that parts of the fixture can rotate, as shown in Figure B.1, to ensure even loading on the left and right bearings. An articulation is also needed to ensure that all the bearings evenly contact the test piece surfaces and apply uniform load. Semi-articulated fixtures have some articulating or tilting capabilities and may be used with test pieces that have flat and parallel surfaces, such as on as-machined test pieces. A semi-articulating fixture has pairs of upper and lower bearings that articulate to match the test piece surfaces, as shown in Figures B.2 and B.3. Fully articulated fixtures have more moving parts and are necessary for test pieces that do not have flat and

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