SLOVENSKI STANDARD
SIST ENV 820-1:2000

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Advanced technical ceramics - Monolithic ceramics - Thermomechanical properties - Part 1: Determination of flexural strength at elevated temperature

Advanced technical ceramics - Monolithic ceramics - Thermomechanical properties - Part 1: Determination of flexural strength at elevated temperature

Hochleistungskeramik - Monolithische Keramik - Thermomechanische Eigenschaften - Teil 1: Bestimmung der Biegefestigkeit bei erhöhten Temperaturen

Céramiques techniques avancées - Céramiques monolithiques - Propriétés thermomécaniques - Partie 1: Détermination de la résistance en flexion a température élevée

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81.060.99	Drugi standardi v zvezi s keramiko	Other standards related to ceramics

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English version

Advanced technical ceramics - Monolithic ceramics - Thermomechanical properties - Part 1: Determination of flexural strength at elevated temperatures

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CEN members are required to announce the existance of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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CEN

European Committee for Standardization
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Europäisches Komitee für Normung

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Contents list

Foreword

This European prestandard has been prepared by Technical Committee CEN/TC 184 'Advanced Technical Ceramics', of which the secetariat is held by BSI.

ENV 820 consists of three Parts:

Part 1 : Determination of flexural strength at elevated temperatures
Part 2 : Determination of self-loaded deformation
Part 3 : Determination of resistance to thermal shock by water quenching

CEN/TC 184 approved this European prestandard by Resolution 2 during its sixth meeting, held in Alkmaar on 1992-09-30.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to announce the existence of this European prestandard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This Part of ENV 820 describes a method of determining the three-point or four-point flexural strength of advanced monolithic technical ceramics at elevated temperatures as agreed between parties to the test. The test may be performed in any appropriate atmosphere.

2 Normative references

This European prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and in the publications listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 843-1	Advanced technical ceramics - Monolithic ceramics - Mechanical properties at room temperature Part 1 : Determination of flexural strength
ENV 843-5	Advanced technical ceramics - Monolithic ceramics - Mechanical properties at room temperature Part 5 : Statistical analysis of fracture data.[1)]
EN 10002-2	Metallic materials - Tensile testing - Part 2 : Verification of the force measuring system of the tensile testing machine.
EN 45001	General criteria for the operation of testing laboratories.
HD 446.1 SI	Thermocouples - Part 1 : Reference tables
HD 446.2 S2	Thermocouples - Part 2 : Tolerances
ISO 3661	Micrometer callipers for external measurements

1) In course of preparation

3 Definitions

For the purposes of this prestandard, the following definitions apply:

3.1 Nominal flexural strength: The maximum nominal stress at the instant of failure supported by the material when loaded in elastic bending.

NOTE: It is recognised that flexural strength tests on ceramics at elevated temperature may reveal inelastic behaviour in the material. Under such conditions, the nominal flexural strength calculated in accordance with this method is not strictly a valid result, since it will tend to overestimate the true surface stress in the test piece. This method requires that the load/displacement relationship for each test piece at each temperature is inspected, and the validity of the result determined.

3.2 Three-point flexure: A means of bending a beam test piece whereby the test piece is supported on bearings near its ends, and a central load is applied.

3.3 Four-point flexure: A means of bending a beam test piece whereby the test piece is supported on bearings near its ends, and is loaded equally at two points symmetrically disposed about the centre of the supported span.

3.4 Inelastic deformation: The deformation of a test specimen under load which is not entirely elastic and reversible on removal of the load.

3.5 Subcritical crack growth: The extension of existing cracks or flaws under load which does not produce instant failure.

NOTE: This effect may be caused by the testing environment, or by the intrinsic crack propagation behaviour of the material.

4 Apparatus

4.1 General

The test is carried out in a similar manner to that prescribed in EN 843-1 for testing at room temperature with the exceptions that the test jig shall be constructed from materials which are capable of remaining linearly elastic at the temperature of testing, and that a means of heating the test jig and test piece to the test temperature is required.

4.1 Test jig

The test jig shall be of a design that allows full articulation for alignment of the support and loading rollers on the surfaces of the test piece, and in which the rollers are capable of rolling to minimise friction between the rollers and the test piece. Details of the jig dimensions and alignment requirements are given in EN 843-1.

The outer span of the test jig shall be either 20 mm ± 0,5 mm (span A) or 40 mm ± 0,5 mm (span B). For three-point flexure the loading roller shall be centralised relative to the span to within 0,2 mm. For four-point flexure, the inner span shall be 10 mm ± 0,2 mm (span A) or 20 mm ± 0,2 mm (span B). The inner rollers shall be symmetrically positioned relative to the outer rollers to better than 0,2 mm.

NOTE 1: This represents a relaxation of centralisation requirements compared with room temperature testing (requirement 0,1 mm, see EN 843-1), because it may become relatively more difficult to set up test jigs inside furnaces.

Measurements of the positions of the rollers shall be made with a travelling microscope (see 4.5.2).

The rollers shall be made from a material which is capable of remaining linearly elastic up to the maximum temperature of the series of tests. For tests to 400 °C, hardened steel rollers as used in EN 843-1 shall suffice. For higher temperatures it is recommended that the test jig is constructed from fine-grained strong refractory ceramic materials.

NOTE 2: For temperatures up to 1400 °C, high-purity high alumina ceramic materials may be used. For temperatures up to 1500 °C in air or up to 1700 °C in neutral atmospheres, sintered silicon carbide is recommended.

Consideration should be given to any potential reaction between the test material and the rollers at the maximum test temperature, and the choice of roller material shall be made such that reactions are minimised. In particular, non-oxide ceramic materials may tend to oxidise, and the oxide then may react with the loading rollers. Rollers shall be maintained with a clean smooth burr-free surface for all tests. They shall be inspected before any test to ensure they are undamaged, and are capable of rolling freely in the jig at the start of the test. If necessary, rollers should be replaced to maintain correct jig function. Similarly, reactions between the main ceramic components of the test jig shall be minimized by appropriate choice of material.

NOTE 3: At very high temperatures, the progressive oxidation of non-oxide jig components may lead to the development of frictional effects due to inability of the rollers to roll freely. Such effects can lead to uncertainties in nominal flexural strength of up to 5 %. It is not possible to quantify this effect, which is likely to be time, temperature and material dependent. Jig components may be found to have welded together on cooling to room temperature. They should be gently separated and cleaned before re-use.

The load shall be applied to the test jig through solid or hollow columns which are loaded by the test machine. These columns shall be of a material which remains linearly elastic to the maximum testing temperature.

NOTE 4: To ascertain this, the columns of the test jig may be brought into contact at the appropriate test temperature with or without the jig in place. A load equivalent to that estimated to be needed to fracture test pieces is applied, and the apparent load displacement relationship is examined for evidence of non-linearity with increasing load (see clause 8).

4.3 Heating device

The test jig shall be contained within a furnace or suitable heating device of design appropriate to the maximum temperature for the tests, and capable of reaching the maximum testing temperature within 3 h.

NOTE 1: The use of very fast heating rates is not recommended because of risk of fracture of ceramic components in the test jig or columns.