SLOVENSKI STANDARD
SIST ENV 658-3:2000

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Advanced technical ceramics - Mechanical properties of ceramic composites at room temperature - Part 3: Determination of flexural strength

Advanced technical ceramics - Mechanical properties of ceramic composites at room temperature - Part 3: Determination of flexural strength

Hochleistungskeramik - Mechanische Eigenschaften von keramischen Verbundwerkstoffen bei Raumtemperatur - Teil 3: Bestimmung der Biegefestigkeit

Céramiques techniques avancées - Propriétés mécaniques des céramiques composites a température ambiante - Partie 3: Détermination de la résistance en flexion

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English version

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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
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Contents list

Foreword

This European Prestandard has been prepared by CEN/TC 184 "Advanced technical ceramics", of which the secretariat is held by BSI.

ENV 658 has six parts:

Part 1: Determination of tensile strength
Part 2: Determination of compressive strength
Part 3: Determination of flexural strength
Part 4: Determination of shear strength by compression loading of notched specimens
Part 5: Determination of shear strength by short span bend test (three-point)
Part 6: Determination of shear strength by double-punch shearing

CEN/TC 184 approved this European Prestandard by resolution 4/1992 during its fifth meeting, held in Brussels on 1992-03-31.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to announce 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 658 specifies the conditions for the determination of the flexural strength of ceramic matrix composite materials with continuous fibre reinforcement, (under three-point or four-point loading) at ambient temperature.

The method applies to all ceramic matrix composites with a continuous fibre reinforcement, unidirectional (1D) bidirectional (2D), and tridirectional (3D), with weak reinforcement in the third direction.

NOTE. The method should not be used to obtain absolute values of flexural strength for design purposes.

2 Normative references

This European pre-standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at 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 10002-2	Metallic materials - Tensile testing - Part 2: Verification of the force measuring system of tensile testing machines
ISO 178	Plastics - Determination of flexural properties of rigid plastics
ISO 3611	Micrometer callispers for external measurements

3 Principle

A test specimen of specified dimensions is fractured in a bend test and the force required is measured. Loading in the direction normal to the plies and the test-specimen dimensions shall be such that failure occurs in the tensile or compressive mode. The test is performed at constant crosshead speed.

4 Definitions and symbols

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

4.1 Flexural failure force, F

The maximum force required to fracture a bend test specimen in a test to failure.

4.2 Flexural stress, σ(f)

The nominal stress in the outer surface of the test specimen, calculated for the mid-span.

4.3 Flexural strength, σ(fm)

The maximum flexural stress applied to a test specimen that fractures during a bend test

5 Apparatus

5.1 Test machine

The test machine shall be equipped with a system for measuring the force applied to the test specimen. The machine shall conform to grade 1 in EN 10002-2.

5.2 Micrometers

Micrometers used for the measurement of the specimen dimensions shall be accurate to ± 0.01 mm and in accordance with ISO 3611.

5.3 Test jig

The test jig is composed of two parts, linked to the fixed and mobile part of the machine. It has two outer support rollers and one (three-point bending) or two (four-point bending) inner support rollers. The diameter of the rollers shall be between 4 mm and 10 mm. Their length shall be at least equal to the width of the test specimen.

The axis of the rollers shall be parallel to the plane defined by the cross section of the test specimen to within ± 0,002 mm/mm (see figure 1).

The outer and inner rollers shall be free to rotate (see figure 2).

Either two or three supports, for three-point or four point bending respectively, shall be free to pivot around an axis parallel to the longitudinal direction of the test specimen, in order to adopt to non-parallelism of the upper and lower test specimen faces.

The inner support(s) shall be centred with respect to the outer supports. The force shall be applied in the plane of symmetry of the test specimen and test jig configuration. In the case of four point bending, a levelling system shall be used to ensure symmetrical loading of the test specimen.

6 Test specimens

Test specimens shall be flat and parallel and manufactured according to a drawing in which the dimensions are specified. For test specimens loaded perpendicularly to the fibre direction(s), the dimensions described in table 1 are recommended.

Table 1 : Recommended test specimen dimensions for 1D, 2D and 3D specimens

(Dimensions in millimetres)

Measurement	Dimension	Tolerance for machined specimen
Total length, L_t	L + 10	± 1
Width	10	± 0,05 to 0,15
Thickness, h	2,5	± 0,15
Inner span four-point bending, L_i	25	± 0,1
Outer span in three-point bending, L	50	± 0,1
Outer span in four-point bending, L	75	± 0,1
Plan parallelism		0,05 to 0,1

NOTE. If the material to be tested needs to be another size, the specimen should be defined according to the requirement : moment arm ≥ 10 h.

7 Test specimen preparation

7.1 Machining

During cutting out, care shall be taken that the specimen axis coincides with one of the fibre directions.

Machining parameters which avoid damage to the material shall be established and documented. These parameters shall be adhered to during test piece preparation.

The test specimen thickness shall be a whole number of plies. At least three individual plies are recommended.

7.2 Number of test specimens

At least three valid test results, as specified in 8.4, are required.

8 Procedure

8.1 Displacement rate

A crosshead speed shall be used which allows test completion within one minute. The speed used shall be reported.

8.2 Measurement of test specimens

The width and thickness shall be measured to the nearest 0,01 mm near the centre for three-point bending and between the inner rollers for four-point bending and at each end of the specimen. The arithmetic means of these measurements shall be documented.

The outer, and for four point bending also the inner span, shall be measured to the nearest 0,1 mm.

8.3 Testing technique

Mount the test specimen in the test jig and centre it with respect to the support rollers. Set the crosshead speed and record force against time during the test.

8.4 Test validity

The following circumstances will invalidate a test:

a) failure to specify and record test conditions,
b) failure to note the mode and location of fracture,
c) fracture of the specimen not occurring in the tensile or compressive mode.

9 Calculation of results

9.1 Test specimen origin

A diagram illustrating the orthotropic directions of the original material shall always accompany the test results.

The area and orientation of test specimens from a material sample shall be indicated as exactly as possible.