SLOVENSKI STANDARD
SIST ENV 1007-4:2000

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Advanced technical ceramics - Ceramic composites - Methods of test for reinforcements - Part 4: Determination of tensile properties of filament at ambient temperature

Advanced technical ceramics - Ceramic composites - Methods of test for reinforcements - Part 4: Determination of tensile properties of filament at ambient temperature

Hochleistungskeramik - Keramikfasern für keramische Verbundwerkstoffe - Faserverstärkungen - Teil 4: Bestimmung von Zugeigenschaften von Fasern bei Raumtemperatur

Céramiques techniques avancées - Renforcement a base de fibres céramiques pour utilisation dans des composites céramiques - Partie 4: Détermination des propriétés en traction du filament a température ambiante

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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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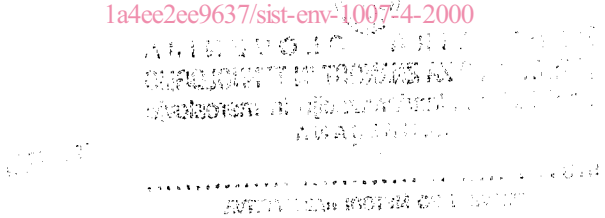
Contents list



Foreword

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

ENV 1007 has four Parts:

Part 1 : Determination of size content
Part 2 : Determination of linear density
Part 3 : Determination of filament diameter
Part 4 : Determination of tensile properties of filament at ambient temperature

CEN/TC 184 approved this European Prestandard by resolution 4 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 1007 specifies the conditions for measurement of tensile strength and elongation at fracture of single filaments of ceramic fibre. The test procedure gives the method for determination of tensile strength and annex B that for determination of the elastic modulus. The method applies to continuous ceramic filaments taken from tows, yarns, staple fibre, braids and knittings, which have strains to fracture less than or equal to 5 % and show linear elastic behaviour to fracture.

The method does not apply to testing for homogeneity of strength properties of fibres, nor to assess the effects of volume under stress. Statistical aspects of fibre failure are not included.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard 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 the tensile testing machine
ENV 1007-1	Advanced technical ceramics - Ceramic composites - Methods of test for reinforcements - Part 1 : Determination of size content
ENV 1007-3	Advanced technical ceramics - Ceramic composites - Methods of test for reinforcements Part 3 : Determination of filament diameter

3 Definitions

For the purposes of this part of ENV 1007, the following definitions apply:

3.1 Test-piece: A single filament mounted on a special mounting tab.

3.2 Mounting tab: A thin paper, flexible metal or plastics strip containing a window, across which the filament is fixed, gripped and pulled in the test machine.

3.3 **Tensile stress:** The ratio of the applied force to the initial filament cross-sectional area.

3.4 **Tensile strength:** The tensile stress in the filament at the moment of fracture.

3.5 **Gauge length:** The initial length between the two attachment points of the single filament to the mounting tab.

3.6 **True elongation:** The increase of the gauge length during the tensile test.

3.7 **System elongation:** The increase in length of the loading and gripping system along the tensile axis.

3.8 **Total elongation:** Sum of the true elongation and the system elongation.

3.9 **True compliance:** The ratio of the true elongation to the corresponding force during a tensile test.

3.10 **System compliance:** The ratio of the system elongation to the corresponding force during a tensile test.

3.11 **Total compliance:** The ratio of the total elongation to the corresponding force during a tensile test.

3.12 **Strain:** The ratio of true elongation to the gauge length, expressed as a percentage.

3.13 **Fracture strain:** The strain at the moment of failure of the filament.

3.14 **Elastic modulus:** The ratio of the tensile strength to the fracture strain.

4 Principle

The test consists of determining the force/elongation behaviour of ceramic filament specimens fixed on a mounting tab and loaded to fracture.

5 Apparatus

5.1 **Test machine,** equipped with a system for measuring the force applied to the testpiece and the elongation. The machine shall conform with grade 1 in EN 10002-2.

The accuracy of the force measurement shall be better than 0,1 % of the maximum force to be measured, and the accuracy of the displacement measurement shall be better than 1 µm. See also annex A.

5.2 **Mounting tab,** of thin paper, metal or plastic, cut as shown in figure 1, with a gauge length window of length appropriate to the length of filament being tested (see clause 6).

5.3 **Adhesive,** suitable for affixing the filament to the ends of the mounting tab, such as epoxy resins, cements or sealing wax.

5.4 **Travelling microscope,** or other suitable measuring device.

6 Test pieces

The filaments for testing are selected at random from the tow, yarn, staple fibre, fabric, braid or knitting according to agreement between parties. For filaments which are sized, the size shall be removed before sampling according to the method described in ENV 1007-1.

The test pieces shall be cut to a length of 44 mm ± 1 mm for filaments of diameter greater than 50 µm, and 30 mm ± 1 mm for filaments of diameter less than 50 µm. The gauge lengths and corresponding window lengths in the mounting tab shall be 25 mm ± 0,5 mm and 10 mm ± 0,5 mm respectively.

At least 30 test pieces shall be prepared.

For the determination of elastic modulus (see annex B), testpieces shall be cut to three different lengths, with gauge lengths of 10 mm and 25 mm as described above, and additionally 70 mm ± 1 mm, for use with a gauge length and mounting tab window length of 50 mm ± 1 mm.

7 Procedure

7.1 Positioning of the filament

Glue the filament to each end of the mounting tab as shown in figure 1 using the adhesive chosen for the tests. Ensure that the axis of the filament is aligned with the axis of the mounting tab within the bounds indicated in figure 2.

Determine the gauge length of the test piece between the glued regions on the ends of the mounting tab to the nearest 0,1 mm, using the travelling microscope or other suitable measuring device.

7.2 Determination of filament diameter and cross-sectional area

After mounting and prior to tensile testing, measure the filament diameter and/or its cross-sectional area in accordance with ENV 1007-3.

7.3 Tensile test

Place the test piece in its mounting tab in the grip system of the test machine and align it as accurately as possible such that the filament is orientated axially in the grips. Misorientation shall be less than 0,5 mm as defined in figure 2.

Before applying load to the testpiece, carefully cut the two sides of the mounting tab at the centre of the gauge length. If the specimen is damaged in this process, discard it.

Apply the tensile load to the filament at a constant elongation rate sufficient to cause failure in less than 10 s.

NOTE : The elongation rate will be different for different gauge length test pieces, and will have to be established by experiment.

Record the applied force versus elongation curve.

Reject any result where failure has occurred outside the gauge length.

8 CALCULATION OF RESULTS

8.1 Tensile strength

Calculate the tensile strength of each filament from the expression:

$$\sigma(t) = \frac{F(m)}{S}$$

where:

$\sigma(t)$ is the tensile strength, expressed in Megapascals;
$F(m)$ is the maximum tensile force, expressed in newtons, (see 7.3);
S is the cross-sectional area of fibre in square millimetres (see 7.2).

8.2 Elastic modulus, E

Determine the elastic modulus according to the compliance method; see annex B.

8.3 Average tensile strength, σ(rm)

Calculate the arithmetic mean of the tensile strengths obtained from 30 test pieces.

8.4 Average strain to failure, ε(rm)

Calculate the average strain to failure from the ratio of the average tensile strength and the elastic modulus E.