SLOVENSKI STANDARD
SIST EN 1007-4:2004

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Sodobna tehniļ na keramika ï Keramiļ ni kompoziti ï Preskusne metode za ojaļ itve ï 4. del: Ugotavljanje nateznih lastnosti vlaken pri sobni temperaturi

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

Hochleistungskeramik - Keramische Verbundwerkstoffe - Verfahren zur Prüfung der Faserverstärkungen - Teil 4: Bestimmung der Zugeigenschaften von Fasern bei Raumtemperatur

Céramiques techniques avancées - Composites céramiques - Méthodes d'essai pour renforts - Partie 4: Détermination des propriétés en traction du filament a température ambiante

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81.060.30	Sodobna keramika	Advanced ceramics

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English version

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

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This European Standard was approved by CEN on 3 March 2004.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Contents

Foreword

This document (EN 1007-4:2004) has been prepared by Technical Committee CEN/TC 184 "Advanced technical ceramics", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2004, and conflicting national standards shall be withdrawn at the latest by November 2004.

This document supersedes ENV 1007-4:1994.

This document includes a Bibliography.

EN 1007 'Advanced technical ceramics – Ceramic composites – Methods of test for reinforcements' has six parts :

— *Part 1: Determination of size content*;

— *Part 2: Determination of linear density*;

— *Part 3: Determination of filament diameter and cross-section area*;

— *Part 4: Determination of tensile properties of filament at ambient temperature*;

— *Part 5: Determination of distribution of tensile strength and of tensile strain to failure of filaments within a multifilament tow at ambient temperature*;

— *Part 6: Determination of tensile properties of filament at high temperature*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This part of EN 1007 specifies the conditions for determination of tensile strength and elongation at fracture of single filaments of ceramic fibre such as tensile strength, Young's modulus and stress-strain curve. The method applies to continuous ceramic filaments taken from tows, yarns, braids and knittings, which have strain to fracture less than or equal to 5 %.

The method does not apply to checking the homogeneity of strength properties of fibres, nor to assessing the effects of volume under stress. Statistical aspects of filament failure are not included.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the 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 Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1007-1, *Advanced technical ceramics – Ceramic composites – Methods of test for reinforcement – Part 1 Determination of size content.*

EN 1007-3, *Advanced technical ceramics - Ceramic composites - Methods of test for reinforcement - Part 3: Determination of filament diameter and cross-section area.*

ENV 13233:1998; *Advanced technical ceramics - Ceramic composites - Notations and symbols.*

EN ISO 7500-1; *Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines (ISO 7500-1:1999).*

3 Principle

A ceramic filament is loaded in tension. The test is performed at constant displacement rate up to failure. Force and cross-head displacement are measured and recorded simultaneously. When required, the longitudinal deformation is derived from the cross-head displacement using a compliance correction.

4 Terms, definitions and symbols

For the purposes of this European Standard, the terms, definitions and symbols given in ENV 13233:1998 and the following apply.

4.1
lengths

4.1.1
gauge length, L_0
initial distance between two reference points on the filament

4.1.2
test specimen length, L_f
initial distance between the gripped ends of the filament

4.2
initial cross section area A_0
initial cross section area of the filament within the gauge length

4.3
maximum tensile force, F_m
highest recorded tensile force on the test specimen when tested to failure

4.4
tensile stress, σ
tensile force supported by the test specimen divided by the initial cross section area

4.5
tensile strength, σ_m
ratio of the maximum tensile force to the initial cross section area

4.6
longitudinal deformation, ΔL
increase of the gauge length during the tensile test

4.7
compliance

4.7.1
total compliance, C_t
inverse of the slope in the linear part of the displacement curve

4.7.2
load train compliance, C_l
ratio of the cross-head displacement excluding any test specimen contribution to the corresponding force during the tensile test

4.8
strain, ε
ratio of the longitudinal deformation to the gauge length

4.9
fracture strain, ε_m
strain at failure of the test specimen

4.10
Young's modulus, E
slope of the linear part of the tensile stress-strain curve

4.11
elementary unit
smallest commercially available unit of a given product

NOTE For fibres this is usually a spool.

5 Apparatus

5.1 Test machine

The machine shall be equipped with a system for measuring the force applied to the test specimen which shall conform to grade 1 according to EN ISO 7500-1. Additionally, the machine shall be equipped with a system for measuring the cross-head displacement with an accuracy better than 1 µm.

5.2 Load train

The grips shall align the test specimen with the direction of the force. Slippage of the filament in the grips shall be prevented.

5.3 Adhesive

A suitable adhesive for fixing the filament ends to the grip, such as epoxy resin or sealing wax.

5.4 Data recording system

Calibrated recorders may be used to record force-displacement curves.

The use of a digital data recording system combined with an analogue recorder is recommended.

6 Test specimens

Specimens with a gauge length of 25 mm shall be used to establish the force-displacement curves.

Specimens with a gauge length of 10 mm and 40 mm shall be used to determine the load train compliance C_1.

The tolerance on the gauge length is ± 1 mm.

7 Test specimen preparation

Extreme care shall be taken during test specimen preparation to ensure that the procedure is repeatable from test specimen to test specimen and to avoid handling damage.

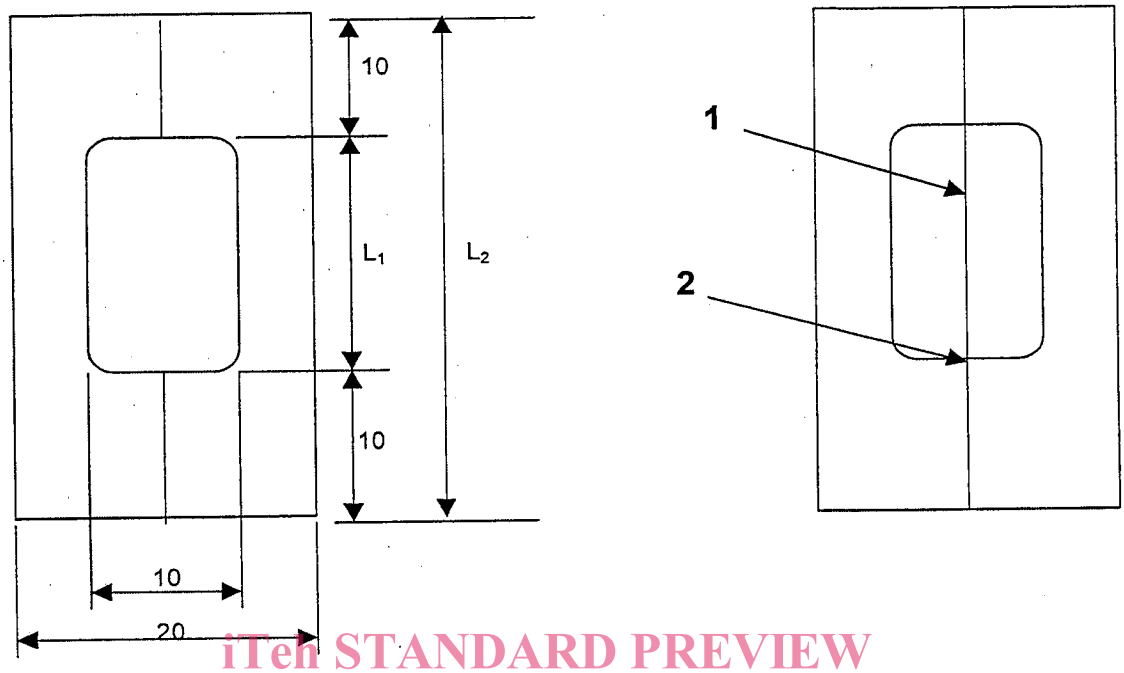
NOTE 1 The introduction of damage during test specimen preparation can result in a truncation of the strength distribution, and is more critical the longer the length of the filament.

NOTE 2 During test specimen preparation, and in particular when extracting a filament from the tow, the ratio of damaged filaments to the total number of extracted filaments should be minimised.

NOTE 3 To prevent damage during test specimen manipulation and mounting, an example of assembly of test specimen is shown in Figure 1. This test specimen preparation uses a mounting tab of thin paper, metal or plastic cut as shown in Figure 1, with a window. The length of the window is equal to the gauge length of the filament test specimen. An adhesive, suitable for affixing the filament to the ends of mounting tab, such as epoxy resins, cements or sealing wax is used for that purpose.

NOTE 4 Another example of assembly can be used to prevent damage during test specimen manipulation and mounting, as shown in Figure 2.

Dimensions in millimetres

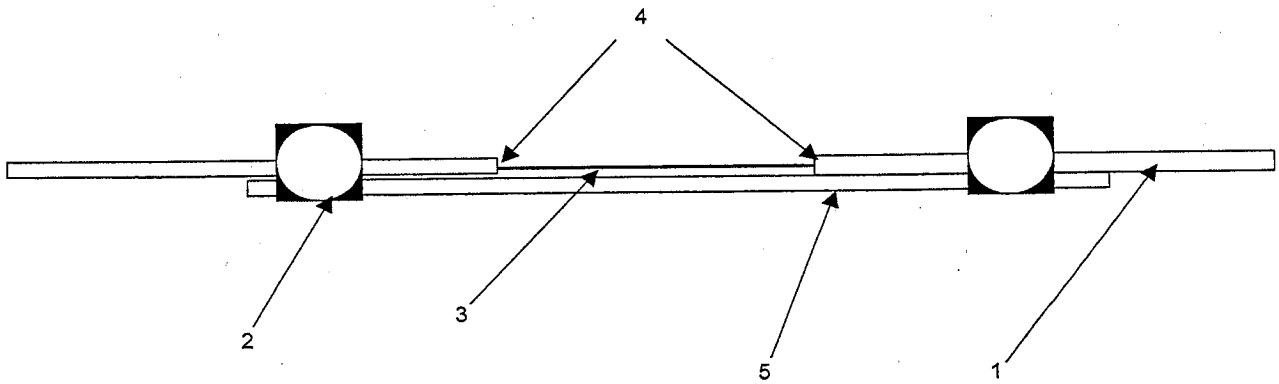


L_1	L_2
10 ± 0,5	30 ± 1
25 ± 0,5	45 ± 1
50 ± 0,5	70 ± 1

Key

1 Filament
2 Glue

Figure 1 – Assembly of test specimen



Key

1 Alumina tubes
2 Temporary screw attachment
3 Test specimen
4 Ceramic cement
5 Alumina rod

Figure 2 – Alternative assembly of test specimen