

Advanced technical ceramics — Ceramic composites — Methods of test for reinforcements —

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

ICS 81.060.99

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National foreword

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This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because it is considered that further experience is required in its application before it is converted into a British Standard. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion into a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee RPI/13, Advanced technical ceramics, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ENV title page, pages 2 to 16 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

Amd. No.	Date	Comments

This Draft for Development, having been prepared under the direction of the Sector Board for Materials and Chemicals, was published under the authority of the Standards Board and comes into effect on 15 July 1998

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English version

Advanced technical ceramics — Ceramic composites —
Methods of test for reinforcements —
Part 5: Determination of distribution of tensile strength and
of tensile strain to failure of filaments within a
multifilament tow at ambient temperature

Céramiques techniques avancées —
Céramiques Composites — Méthodes d'essais
pour les renforts —
Partie 5: Détermination des distributions des
résistances en traction et des déformations de
traction à rupture des filaments dans un fil à
température ambiante

This European Prestandard (ENV) was approved by CEN on 27 June 1998 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence 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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Foreword

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

ENV 1007 has five parts:

- *Part 1: Determination of size contents;*
- *Part 2: Determination of linear density;*
- *Part 3: Determination of filament diameter;*
- *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.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom

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1 Scope

This part of ENV 1007 specifies the conditions for the determination of the distribution of strength and rupture strain of ceramic filaments within a multifilament tow at room temperature by performing a single tensile test on a multifilament tow.

This part of European prestandard applies to tows of continuous ceramic filaments which are assumed to act freely and independently under loading, and behave linearly elastic up to failure.

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 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.*

ISO 10119, *Determination of the density of carbon fibres.*

ENV 1007-2, *Advanced technical ceramics — Ceramic composites — Methods of test for reinforcements — Part 2: Determination of linear density.*

ENV 1007-4, *Advanced technical ceramics — Ceramic composites — Methods of test for reinforcements — Part 4: Determination of tensile properties of filament at ambient temperature.*

ENV 843-5, *Advanced technical ceramics — Monolithic ceramics — Mechanical tests at room temperature — Statistical analysis.*

3 Principle

A multifilament tow is loaded in tension at a constant displacement rate up to rupture of all the filaments in the tow. The force and displacement are measured and recorded. From the force-displacement curve the two-parameter Weibull distribution of the rupture strain and of the strength of the filaments is obtained by sampling the non-linear parts of the curve at discrete intervals j , which correspond to an increasing number of failed filaments in the tow.

The linear part of the force-displacement curve may be used to determine Young's modulus of the filament.

4 Significance and use

Because measurement of the displacement directly on the tow is difficult, it is usually obtained indirectly via a compliance measurement which includes contributions of the loading train, of the grips, of the tabbing materials, etc.. These contributions have to be corrected for in the analysis. When it is possible to measure the tow elongation directly (by using a suitable extensometer system) this correction is not needed. The calculation of the results in clause 10 also applies in this case by setting the load train compliance equal to zero.

The evaluation method is based on an analysis of the non linear increasing and decreasing parts of the force-displacement curve, which are caused by progressive filament failure during the test. The occurrence of these stages is promoted by a higher stiffness of the loading and gripping system. When the force-displacement curve does not show these non linear parts the evaluation method of this prestandard cannot be applied.

The distribution of filament rupture strain does not depend on the number of filaments in the tow and is hence not affected by the number of filaments which are broken before the test. The determination of the filament strength distribution and of the elastic modulus requires knowledge of the initial cross sectional area of the tow. Because the number of unbroken filaments within the tow prior to the test is usually unknown, the values for the filament strength and for the elastic modulus necessarily represent lower bounds to these quantities. Also, the variation in filament diameter, which affects the strength values, is not accounted for.

Because of the difference in the evaluation, the values of the Weibull modulus for the filament rupture strain and for the filament strength are slightly different.