

# Advanced technical ceramics — Monolithic ceramics — Thermomechanical properties —

## Part 4: Determination of flexural creep deformation at elevated temperatures

ICS 81.060.30

# National foreword

This Draft for Development is the English language version of ENV 820-4:2002.

**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 to a European and hence 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, 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, the ENV title page, pages 2 to 18, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

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**Amendments issued since publication**

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English version

**Advanced technical ceramics - Monolithic ceramics -  
Thermomechanical properties - Part 4: Determination of flexural  
creep deformation at elevated temperatures**

Hochleistungskeramik - Monolithische Keramik -  
Thermomechanische Eigenschaften - Teil 4: Bestimmung  
der Kriechverformung unter Biegebeanspruchung bei  
erhöhten Temperaturen

This European Prestandard (ENV) was approved by CEN on 22 June 2001 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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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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.

EN 820 consists of four 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;
- Part 4: Determination of flexural creep deformation at elevated temperatures.

This standard includes a bibliography.

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.

## 1 Scope

This Part of ENV 820 describes a procedure for undertaking flexural creep tests at elevated temperatures on advanced technical ceramics, mainly for the purposes of comparison of deformation behaviour of materials under stressed conditions and under any appropriate atmospheric condition.

NOTE This prestandard does not provide a method of acquiring engineering performance data since the stress distribution under flexural loading is indeterminate.

## 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 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 (including amendments).

- |                  |                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENV 820-1        | Advanced technical ceramics - Monolithic ceramics - Thermo-mechanical properties - Part 1: Determination of flexural strength at elevated temperatures |
| EN 843-1         | Advanced technical ceramics - Monolithic ceramics - Mechanical properties at room temperature - Part 1: Determination of flexural strength             |
| ENV 1006         | Advanced technical ceramics - Methods of testing monolithic ceramics - Guidance on the sampling and selection of test pieces                           |
| EN 10002-2       | Metallic materials - Tensile testing - Part 2: Verification of the force measuring system of the tensile testing machines.                             |
| EN 60584-1       | Thermocouples - Part 1: Reference tables (IEC 60584-1: 1995)                                                                                           |
| EN 60584-2       | Thermocouples - Part 2: Tolerances (IEC 60584-2: 1989 + A1: 1989)                                                                                      |
| EN ISO/IEC 17025 | General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999)                                                   |
| ISO 3611         | Micrometer callipers for external measurement                                                                                                          |

### 3 Terms and definitions

For the purposes of this Part of ENV 820 the following terms and definitions apply.

#### 3.1

##### **creep**

the time-dependent non-elastic deformation of a material under an applied stress

#### 3.2

##### **creep rupture**

the failure of a test piece under nominally constant loading conditions resulting from an accumulation of microstructural damage

#### 3.3

##### **stress rupture**

the catastrophic extension of a flaw having previously grown subcritically under constant nominal stress leading to failure of the test piece

#### 3.4

##### **subcritical crack growth**

the extension of existing cracks or flaws under stress which does not produce instant failure

### 4 Significance and use

The test is intended to evaluate the deformation of a test piece under nominally constant force as a function of time at elevated temperatures. In particular it can be used for materials comparison, or for determining the temperature at which creep deformation becomes significant for a prospective engineering use.

During the course of such a test, the test piece can fracture. This can be due either to a subcritical crack growth process unrelated to the mechanism of creep (stress rupture), or to the accumulation of creep damage leading to acceleration of creep rate and the linking of damage to form cracks (creep rupture). In some circumstances it is not possible to distinguish the mechanism of failure. In either case, the test piece lifetime under the imposed temperature and stress conditions can be an important aspect of a material's performance.

The analysis given in this Prestandard (see 8.6) produces purely nominal data, assuming that the actual maximum nominal stress in the test piece is linearly proportional to the test force applied and is constant during the test. Moreover, an additional assumption of linear dependence of strain on stress is made for some deflection measurement methods. Furthermore, it does not give engineering creep data equivalent to separate pure tensile or compressive conditions. In many cases, the creep rate dependence is to the maximum stress, and can differ in tension and compression. Typically, the true maximum stress in the test piece is less than that calculated using equation 1 because of faster relaxation at higher stress levels, and the true surface strain rate can be greater than a linear prediction in certain geometrical arrangements for determining the deformation, particularly if this is done using the relative displacement of the loading system. The Bibliography contains references to more detailed theoretical analyses of flexural creep accounting for such non-linearities.