



**SLOVENSKI STANDARD**  
**SIST-TS CEN/TS 15365:2006**  
**01-julij-2006**

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gdU`Ub`UfWt`X`YbX`a Yh cXŁ

Advanced technical ceramics - Mechanical properties of ceramic fibres at high temperature in a non-reactive environment - Determination of creep behaviour by the cold end method

Hochleistungskeramik - Mechanische Eigenschaften von Keramikfasern bei hohen Temperaturen in einer reaktionsfreien Umgebung - Bestimmung des Kriechverhaltens im Kaltverbindungsverfahren

Céramiques techniques avancées - Propriétés mécaniques des fibres céramiques a haute température sous environnement non-réactif - Détermination du comportement au fluage par la méthode des mors froids

**Ta slovenski standard je istoveten z: CEN/TS 15365:2006**

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**ICS:**

81.060.30

**SIST-TS CEN/TS 15365:2006**

**en**

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ICS 81.060.30

English Version

**Advanced technical ceramics - Mechanical properties of ceramic fibres at high temperature in a non-reactive environment - Determination of creep behaviour by the cold end method**

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This Technical Specification (CEN/TS) was approved by CEN on 30 January 2006 for provisional application.

The period of validity of this CEN/TS 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 CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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## Foreword

This Technical Specification (CEN/TS 15365:2006) has been prepared by Technical Committee CEN/TC 184 “Advanced technical ceramics”, the secretariat of which is held by BSI.

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

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## 1 Scope

This Technical Specification specifies the conditions for the determination of the tensile creep deformation and failure behaviour of single filaments of ceramic fibres at high temperature and under test conditions that prevent changes to the material as a result of chemical reaction with the test environment.

This Technical Specification applies to continuous ceramic filaments taken from tows, yarns, braids and knittings, which have strains to fracture less than or equal to 5 %.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ENV 13233:1998, *Advanced technical ceramics — Ceramic composites - Notations and symbols*

EN 60584-1, *Thermocouples — Part 1: Reference tables (IEC 60584-1:1995)*

EN 60584-2, *Thermocouples — Part 2: Tolerances (IEC 60584-2:1982 + A1:1989)*

## 3 Terms and definitions

For the purposes of this Technical Specification, the terms and definitions given in ENV 13233:1998 and the following apply.

### 3.1

#### **creep**

time-dependent increase of gauge length starting from the time when the constant specified level of force is reached

### 3.2

#### **creep threshold temperature, $T_t$**

minimum temperature at which creep is detected

### 3.3

#### **specimen temperature, $T$**

temperature which varies along the fibre length in the cold grips case (see 8.2)

### 3.4

#### **difference in temperature between the different furnace zones, $\Delta T$**

set by the operator

### 3.5

#### **specimen temperature in the zone, $T_i$**

temperature defined as:  $T_t \leq T_i \leq T_t + i \Delta T$

### 3.6

#### **total length, $L$**

total length of the ceramic filament between the grips

### 3.7

#### **length, $L_i$**

length of the ceramic filament at temperature  $T_i$

**3.8****initial effective cross sectional area,  $A_0$** 

initial cross sectional area of the ceramic filament within the gauge length

**3.9****applied tensile force,  $F$** 

constant force applied to the ceramic filament during the test

**3.10****applied tensile stress,  $\sigma$** 

applied tensile force divided by the initial cross sectional area

**3.11****longitudinal deformation,  $\Delta L$** 

change in the total length of the ceramic filament caused by creep

**3.12****longitudinal deformation,  $\Delta L_i$** 

change of the filament caused by creep at temperature  $T_i$

**3.13****tensile creep strain,  $\varepsilon_{cr}(T)$** 

relative change in length in the controlled zone at time  $t$ , caused by creep at the temperature  $T$

NOTE The value corresponding to rupture is denoted  $\varepsilon_{cr,m}$ .

**3.14****creep rupture time,  $t_{cr,m}$** 

time elapsed from the moment when loading is completed until the moment of rupture

**3.15****creep strain rate,  $\dot{\varepsilon}_{cr}(T)$** 

change in creep strain per unit time at time  $t$  at the temperature  $T_i$

**3.16****creep types**

primary, secondary and tertiary creep

**3.17****primary creep**

part of the creep strain versus time curve which presents a decreasing creep strain rate (see Figure 1)

**3.18****secondary creep**

part of the creep strain versus time curve which presents a constant creep strain rate (see Figure 1)

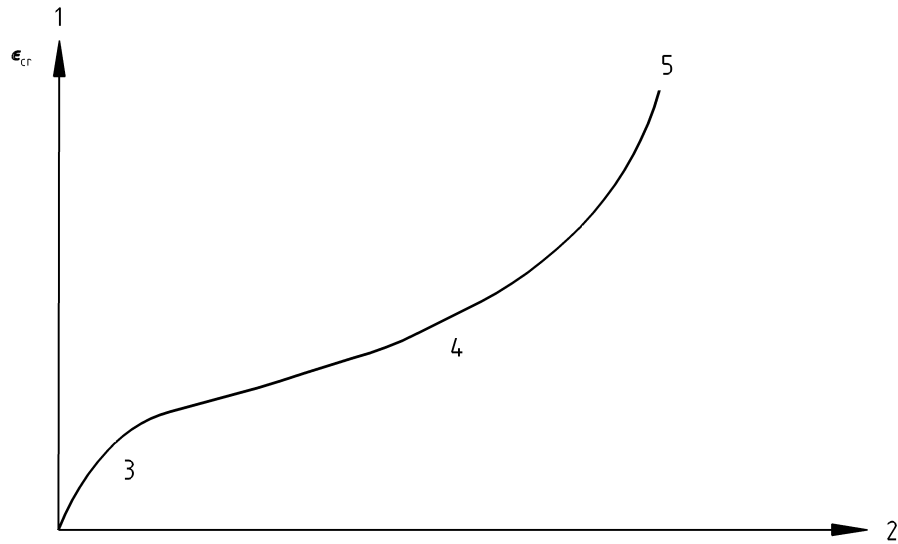
**3.19****tertiary creep**

part of the creep strain versus time curve which presents an increasing creep strain rate (see Figure 1)

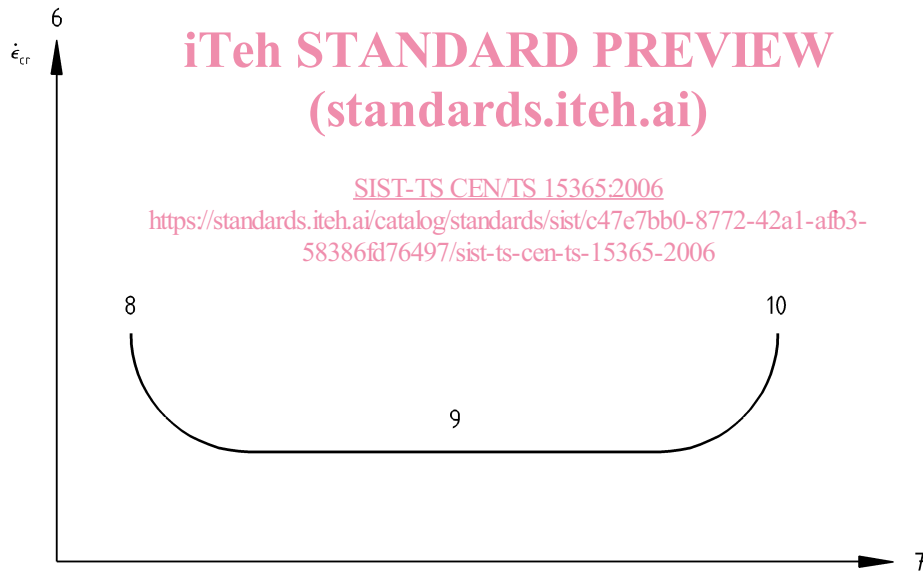
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a) Creep strain versus time



b) Creep strain rate versus time

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**Key**

- |                                |  |
|--------------------------------|--|
| 1 Creep strain $\epsilon_{cr}$ | 6 Creep strain rate $\dot{\epsilon}_{cr}$ (creep strain with time) |
| 2 Time $t$                     | 7 Time   |
| 3 Primary creep                | 8 Primary creep  |
| 4 Secondary creep              | 9 Secondary creep  |
| 5 Tertiary creep               | 10 Tertiary creep  |

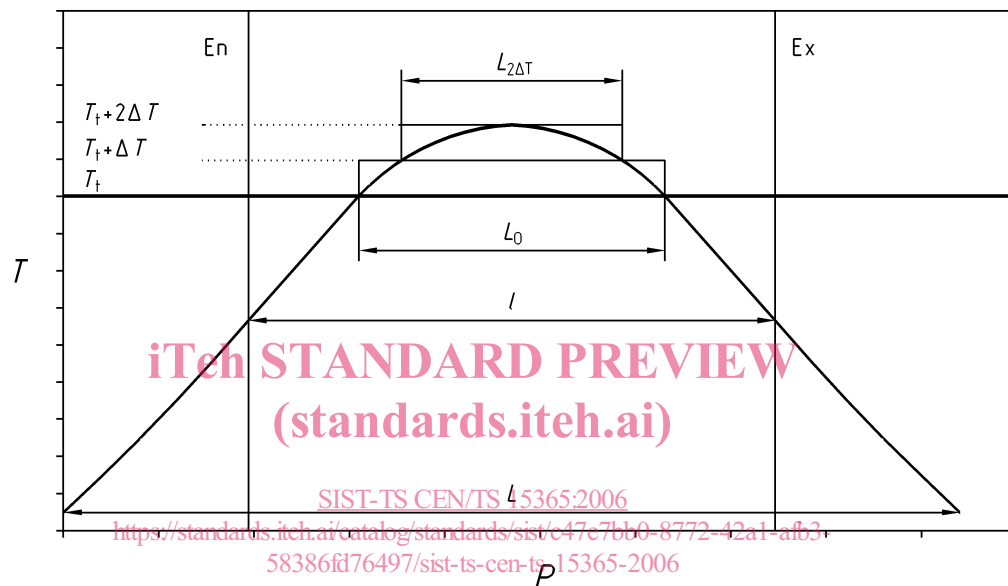
Figure 1 — Creep strain and creep strain rate versus time curves



## 4 Principle

A ceramic filament is heated to the test temperature and loaded in tension until a specified level of force. This force is maintained at a constant level for a specified time or until rupture. The variation in the ceramic filament length is recorded in relation to time.

The specimen is held in cold grips and heated by a furnace. This experimental configuration provokes temperature variations along the filament, which have to be taken into account in order to determine the creep properties as function of temperature. Prior to testing, the temperature profile inside the furnace is established over the temperature range. The temperature range is then divided into several temperature zones defined by the operator, according to the following graph.



### Key

- $T$  Temperature ( $^{\circ}\text{C}$ )
- $l$  Length of the furnace
- $P$  Position (mm)
- En Entrance
- Ex Exit

**Figure 2 — Temperature profile in furnace**

If  $T_t$  is considered to be the lowest temperature at which creep is observed, the temperature profile can be divided in several intervals as a function of  $T_t$  and  $\Delta T$ , where  $\Delta T$  is the difference in temperature between the different zones, fixed by the operator.

If we consider  $i$ , the entire number of zones, and  $L$ , the total fibre length, then we can define the following lengths:

- $L_{20}$  is the furnace length where the temperature  $T$  is in the range  $20^{\circ}\text{C} \leq T \leq T_t$ ;
- $L_{\Delta T}$  is the furnace length where the temperature  $T$  is in the range  $T_t \leq T \leq T_t + \Delta T$ ;
- $L_{2\Delta T}$  is the furnace length where the temperature  $T$  is in the range  $T_t + \Delta T \leq T \leq T_t + 2\Delta T$ ;
- $L_{i\Delta T}$  is the furnace length where the temperature  $T$  is in the range  $T_t + (i - 1)\Delta T \leq T \leq T_t + i\Delta T$ .