



SLOVENSKI STANDARD
SIST-TS CEN/TS 15658:2007
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Advanced technical ceramics - Mechanical properties of ceramic fibres at high temperature under non-reactive environment - Determination of creep behaviour by the hot end method

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

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 chauds

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ICS:

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English Version

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

Céramiques techniques avancées - Propriétés mécaniques
des fibres céramiques à haute température sous
environnement non réactif - Détermination du
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Hochleistungskeramik - Mechanische Eigenschaften von
Keramikfasern bei hohen Temperaturen in einer
reaktionsfreien Umgebung - Bestimmung des
Kriechverhaltens im Heißverbindungsverfahren

This Technical Specification (CEN/TS) was approved by CEN on 20 August 2007 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 document (CEN/TS 15658:2007) has been prepared by Technical Committee CEN/TC 184 “Advanced technical ceramics”, the secretariat of which is held by BSI.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, 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 the 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 knitted structures, that have strains to failure 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.

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

EN 1007-4, *Advanced technical ceramics — Ceramic composites — Methods of test for reinforcement — Part 4: Determination of tensile properties of filaments at ambient temperature*

CEN/TR 13233:2007, *Advanced technical ceramics — Notations and symbols*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*

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 document, the terms and definitions given in CEN/TR 13233:2007 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 gauge length

L_0
initial distance between the gripped ends of filament

3.3 test temperature

T
temperature of the filament in the gauge length

3.4 initial cross section area

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

3.5 applied tensile force

F

constant force applied to the filament during the test

3.6 applied tensile stress

σ

applied tensile force divided by the initial cross sectional area

3.7 longitudinal deformation

ΔL

change of the gauge length L_0 caused by creep

3.8 creep rupture time

$t_{cr,m}$

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

3.9 creep strain rate

$\dot{\epsilon}_{cr}(T)$

change in creep strain per unit time at time t at the temperature T

3.10 Creep types

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3.10.1 primary creep

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

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3.10.2 secondary creep

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

3.10.3 tertiary creep

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

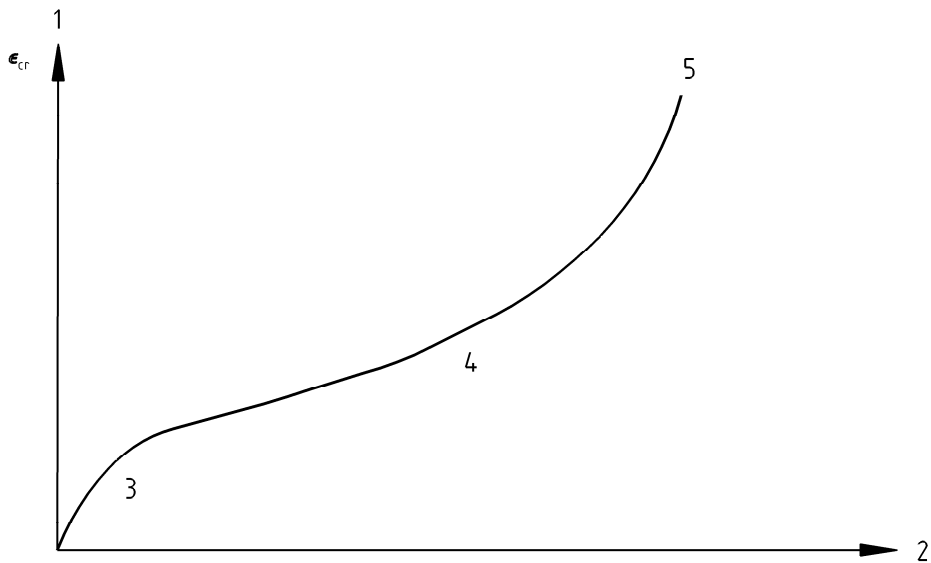


Figure 1a) — Creep strain versus time

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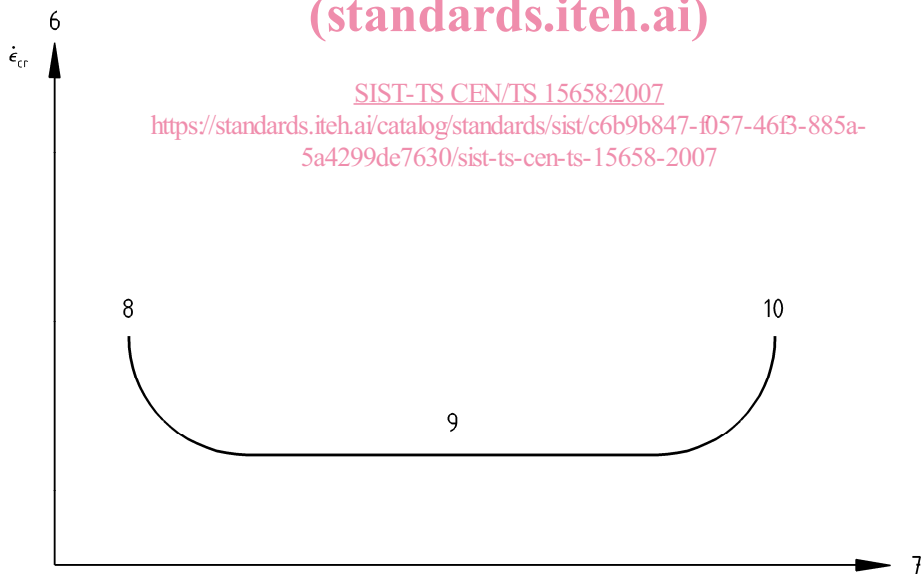


Figure 1b) — Creep strain rate versus time

Key

- | | | | |
|---|------------------------------|----|--|
| 1 | creep strain ϵ_{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 curve

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 filament is heated over its total length. The temperature is uniform over the gauge length. However subjecting the whole length of a filament to temperatures well above 1 000 °C may make it difficult to fix the ends of the test specimen into appropriate temperature proof extensions. However experimental solutions based on electric heating of fibre allow this difficulty to be alleviated at temperatures above 1 000 °C.

5 Significance and use

Creep tests allow the determination of data that characterize the deformation rate of materials under constant load at high temperatures. These are useful for the design of industrial parts with close control of tolerances for high temperature applications.

6 Apparatus

6.1 Test installations

6.1.1 General

Two different types of installation can be used, as described in 6.1.2 and 6.1.3.

6.1.2 Test machine

The machine shall be equipped with a system for measuring the force applied to the test specimen and a system for monitoring the applied load. The machine shall have a load cell with a resolution of 10^{-3} N for the applied force. This shall prevail during actual test conditions (pressure, temperature).

Care shall be taken to ensure that the force applied to the filament remains constant to within 10^{-3} N, even when the material properties change and the environmental conditions (temperature, pressure) fluctuate.

6.1.3 Creep testing rig

When a creep testing rig is used, the force application system shall be calibrated.

The testing rig shall be equipped with a system that allows smooth loading of the ceramic filament(s). When this system is used, care shall be taken to ensure that the force applied to the filament remains constant to within 10^{-3} N, even when the material properties change and the environmental conditions (temperature, pressure) fluctuate.

6.2 Load train

The gripping system shall align the test specimen axis with that of the applied force.

The load train configuration shall ensure that the load indicated by the load cell and the load experienced by the test specimen are the same. The load train performance including the alignment and the force transmission shall not change because of heating.

6.3 Adhesive

Use a suitable adhesive for fixing the filament ends to the grip, such as ceramic cement.