

Advanced technical ceramics — Mechanical properties of ceramic composites at high temperature under inert atmosphere — Determination of fatigue properties at constant amplitude

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National foreword

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A list of organizations represented on RPI/13 can be obtained on request to its secretary.

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English Version

**Advanced technical ceramics - Mechanical properties of ceramic
composites at high temperature under inert atmosphere -
Determination of fatigue properties at constant amplitude**

Céramiques techniques avancées - Propriétés mécaniques
des céramiques composites à haute température sous
atmosphère inerte - Détermination des propriétés de
fatigue à amplitude constante

Hochleistungskeramik - Mechanische Eigenschaften von
keramischen Verbundwerkstoffen bei hoher Temperatur in
inertter Atmosphäre - Bestimmung der
Dauerschwingeigenschaften bei Belastung mit konstanter
Amplitude

This European Standard was approved by CEN on 14 July 2006.

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Foreword

This document (EN 15158:2006) 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of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.

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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies the conditions for the determination of constant-amplitude of load or strain in uniaxial tension/tension or in uniaxial tension/compression cyclic fatigue properties of ceramic matrix composite materials (CMCs) with fibre reinforcement for temperature up to 2 000 °C under vacuum or a gas atmosphere which is inert to the material under test.

NOTE Test environments are specified which are intended to prevent the material under test from chemically reacting with them.

This European Standard applies to all ceramic matrix composites with fibre reinforcement, unidirectional (1D), bi-directional (2D), and tri-directional (xD, where $2 < x \leq 3$).

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 658-1, *Advanced technical ceramics — Mechanical properties of ceramic composites at room temperature — Part 1: Determination of tensile properties*

EN 1892, *Advanced technical ceramics — Mechanical properties of ceramic composites at high temperature under inert atmosphere — Determination of tensile properties*

EN 1893, *Advanced technical ceramics — Mechanical properties of ceramic composites at high temperature in air at atmospheric pressure — Determination of tensile properties*

EN 12291, *Advanced technical ceramics — Mechanical properties of ceramic composites at high temperature in air at atmospheric pressure — Determination of compression properties*

prCEN/TR 13233:2007¹, *Advanced technical ceramics — 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)*

EN ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system (ISO 7500-1:2004)*

EN ISO 9513, *Metallic materials — Calibration of extensometers used in uniaxial testing (ISO 9513:1999)*

ISO 3611, *Micrometer callipers for external measurement*

¹ To be published in 2007

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in prCEN/TR 13233:2007 and the following apply.

3.1

test temperature, T

temperature of the test specimen at the centre of the gauge length

3.2

calibrated length, l

part of the test specimen which has uniform and minimum cross-section area

3.3

gauge length, L_0

initial distance between reference points on the test specimen in the calibrated length

3.4

controlled temperature zone

part of the calibrated length including the gauge length where the temperature is within 50 °C of the test temperature

3.5

initial cross-section area, S_0

initial cross-section area of the test specimen within the calibrated length, at the test temperature

NOTE Two initial cross-section areas of the test specimen can be defined:

- apparent cross-section area: this is the total area of the cross-section $S_{0 \text{ app}}$;
- effective cross-section area: this is the total area corrected by a factor, to account for the presence of a coating,

$S_{0 \text{ eff}}$.

3.6

longitudinal deformation, A

change in the gauge length between reference points under a uniaxial force

3.7

strain, ε

relative change in the gauge length defined as the ratio A/L_0

3.8

stress, σ

force supported by the test specimen at any time in the test, divided by the initial cross-section area

NOTE Two stresses can be distinguished:

- apparent stress, σ_{app} , when the apparent cross-section area (or total cross-section area) is used;
- effective stress, σ_{eff} , when the effective cross-section area is used.

Stress can be either in tension or in compression.

3.9

constant amplitude loading

in cyclic fatigue loading, constant wave form loading in which the peak loads and the valley loads are kept constant during the test (see Figure 1 for nomenclature relevant to cyclic fatigue testing)