SLOVENSKI STANDARD
SIST EN 15156:2007
01-januar-2007

Sodobna tehniļ na keramika - Mehanske lastnosti keramiļ nih kompozitov pri sobni temperaturi - Doloļ anje lastnosti utrujanja pri konstantni amplitudi

Advanced technical ceramics - Mechanical properties of ceramic composites at room temperature - Determination of fatigue properties at constant amplitude

Hochleistungskeramik - Mechanische Eigenschaften von keramischen Verbundwerkstoffen bei Raumtemperatur - Bestimmung der Dauerschwingeigenschaften bei Belastung mit konstanten Amplitude

Céramiques techniques avancées - Propriétés mécaniques des céramiques composites a température ambiante - Détermination des propriétés de fatigue a amplitude constante

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81.060.30	Sodobna keramika	Advanced ceramics

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Advanced technical ceramics - Mechanical properties of ceramic composites at room temperature - Determination of fatigue properties at constant amplitude

Céramiques techniques avancées - Propriétés mécaniques des céramiques composites à température ambiante - Détermination des propriétés de fatigue à amplitude constante

Hochleistungskeramik - Mechanische Eigenschaften von keramischen Verbundwerkstoffen bei Raumtemperatur - Bestimmung der Dauerschwingeigenschaften bei Belastung mit konstanter Amplitude

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

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 15156:2006) 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of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.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 at room temperature.

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 13233:2007[1], *Advanced technical ceramics — Notations and symbols*

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*

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
calibrated length, l
part of the test specimen which has uniform and minimum cross-section area

3.2
gauge length, L_0
initial distance between reference points on the test specimen in the calibrated length

[1] To be published in 2007

3.3
initial cross-section area, S_o
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 $S_{o\ app}$;

- effective cross-section area: this is the total area corrected by a factor, to account for the presence of a coating, $S_{o\ eff}$.

3.4
longitudinal deformation, A
change in the gauge length between reference points under an uniaxial force

3.5
strain, ε
relative change in the gauge length defined as the ratio A/L_o

3.6
stress, σ
force supported by the test specimen at any time in the test, divided by the initial cross-section area

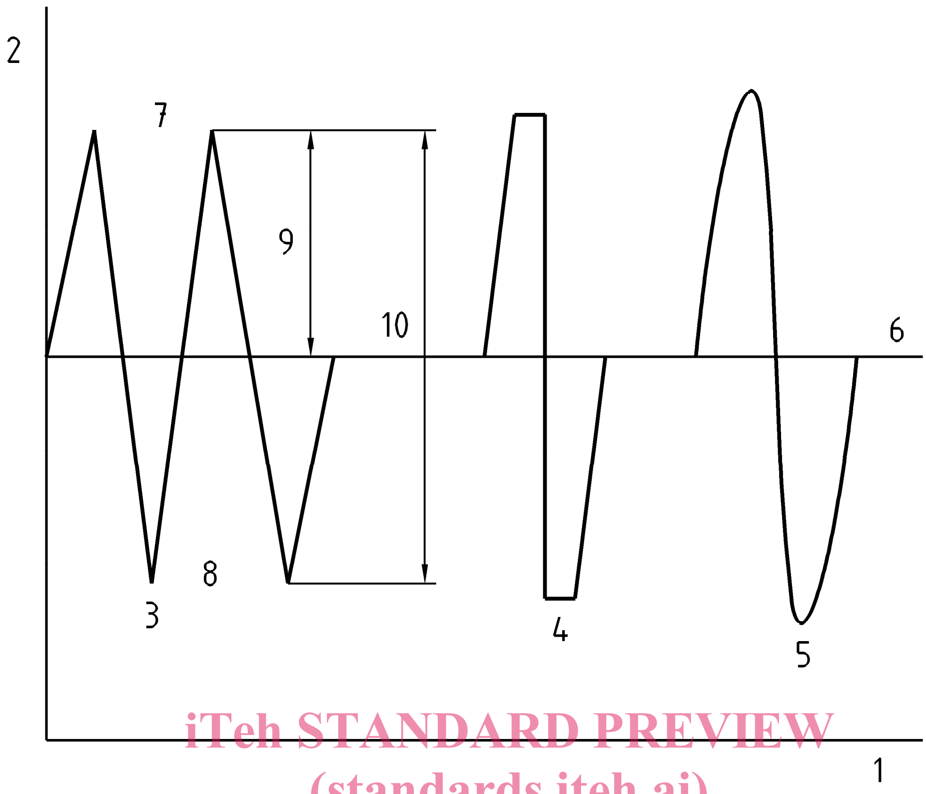
NOTE Two stresses can be distinguished:

- 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.

3.7
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)



Key

1 time
2 control parameter (test mode)
3 triangular form
4 trapezoidal form
5 sinusoidal form
6 mean
7 peak (maximum)
8 valley (minimum)
9 amplitude
10 range

Figure 1 — Cyclic fatigue nomenclature and wave forms

3.8 Cyclic fatigue phenomena

3.8.1
load ratio, R
in cyclic fatigue loading, the algebraic ratio of the two loading parameters of a cycle

NOTE the most widely used ratios are:

R = (minimum load/maximum load) or

R = (valley load/peak load).

3.8.2 Stress cyclic fatigue

3.8.2.1
maximum stress, σ_{max}
maximum applied stress during cyclic fatigue

3.8.2.2
minimum stress, σ_{min}
minimum applied stress during cyclic fatigue

3.8.2.3
mean stress, σ_m
average applied stress during cyclic fatigue such that:

$$\sigma_m = (\sigma_{max} + \sigma_{min})/2$$

3.8.2.4
stress amplitude, σ_a
difference between the maximum stress and the minimum stress, such that:

$$\sigma_a = (\sigma_{max} - \sigma_{min})/2 = \sigma_{max} - \sigma_m = \sigma_m - \sigma_{min}$$

3.8.3 Strain cyclic fatigue

3.8.3.1
maximum strain, ε_{max}
maximum applied strain during cyclic fatigue

3.8.3.2
minimum strain, ε_{min}
minimum applied strain during cyclic fatigue

3.8.3.3
mean strain, ε_m
average applied strain during cyclic fatigue such that:

$$\varepsilon_m = (\varepsilon_{max} + \varepsilon_{min})/2$$

3.8.3.4
strain amplitude, ε_a
difference between the maximum stress and the minimum stress, such that:

$$\varepsilon_a = (\varepsilon_{max} - \varepsilon_{min})/2 = \varepsilon_{max} - \varepsilon_m = \varepsilon_m - \varepsilon_{min}$$

3.8.4 Fatigue parameters

3.8.4.1
number of cycles, N
total number of loading cycles which is applied to the test specimen during the test

3.8.4.2
cyclic fatigue life, N_f
total number of loading cycles which is applied to the test specimen up to failure

3.8.4.3
time to failure, t_f
time duration required to obtain the number of cycles N_f

3.8.5 Stress-strain curve parameters

Stress-strain curve parameters are defined as given in Figure 2.