SLOVENSKI STANDARD

oSIST prEN ISO 4255:2024

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Fina keramika (sodobna keramika, sodobna tehnična keramika) - Mehanske lastnosti keramičnih kompozitov pri visoki temperaturi - Ugotavljanje enoosnih nateznih lastnosti cevi (ISO/DIS 4255:2024)

Fine ceramics (advanced ceramics, advanced technical ceramics) - Mechanical properties of ceramic composites at high temperature - Determination of uniaxial tensile properties of tubes (ISO/DIS 4255:2024)

Hochleistungskeramik - Mechanische Eigenschaften von keramischen Verbundwerkstoffen bei hoher Temperatur - Bestimmung der uniaxialen Zugeigenschaften von Rohren (ISO/DIS 4255:2024)

Céramiques techniques - Propriétés mécaniques des composites céramiques à haute température - Détermination des propriétés en traction axiale de tubes (ISO/DIS 4255:2024)

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ICS:

81.060.30	Sodobna keramika	Advanced ceramics

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DRAFT International Standard

ISO/DIS 4255

Fine ceramics (advanced ceramics, advanced technical ceramics) — Mechanical properties of ceramic composites at high temperature — Determination of uniaxial tensile properties of tubes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Mechanical properties of ceramic composites at high temperature — Determination of uniaxial tensile properties of tubes

1 Scope

This document specifies the conditions for the determination of uniaxial tensile properties of ceramic matrix composite (CMC) tubes with continuous fibre-reinforcement at elevated temperature in air, vacuum and inert gas atmospheres. This document is specific to the tubular geometries because fibre architecture and specimen geometry factors in composite tubes are distinctly different from those in flat specimens.

This document provides information on the axial tensile properties and stress-strain response in temperature, such as axial tensile strength, axial tensile strain at failure and elastic constants. The information can be used for material development, control of manufacturing (quality insurance), material comparison, characterization, reliability and design data generation for tubular components.

This document addresses, but is not restricted to, various suggested test piece fabrication methods. It applies primarily to ceramic matrix composite tubes with a continuous fibrous-reinforcement: unidirectional (1D, filament winding and tape lay-up), bi-directional (2D, braid and weave) and multi-directional (xD, with $x > 2$), tested along the tube axis.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Design and metrological characteristics of micrometers for external measurements*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

ISO 17161, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Ceramic composites — Determination of the degree of misalignment in uniaxial mechanical tests*

ISO 19634, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Ceramic composites — Notations and symbols*

ISO 20507, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Vocabulary*

ISO 20323:2018, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Mechanical properties of ceramic composites at ambient temperature in air atmospheric pressure — Determination of tensile properties of tubes*

IEC 60584-1:2013, *Thermocouples — Part 1: EMF specifications and tolerances*

ASTM E2208-02, *Standard Guide for Evaluating Non-Contacting Optical Strain Measurement Systems*

ISO 6892-1:2019, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 20507, ISO 19634 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
test temperature
T
temperature of the test piece at the centre of the gauge length

3.2
calibrated length
l
part of the test specimen that has uniform and minimum cross-section area

[SOURCE: ISO 20504:2022, 3.1]

3.3
gauge length
L_0
initial distance between reference points on the test specimen in the *calibrated length* (3.2)

[SOURCE: ISO 20504:2022, 3.2]

3.4
controlled temperature zone
part of the *calibrated length* (3.2) including the *gauge length* (3.3) where the temperature is controlled within a range of 20 °C of the test temperature

3.5
internal diameter
d_i
inner distance through the centre of the tube from one side to the other in the *gauge length* (3.3)

[SOURCE: ISO 21971:2019, 3.4]

3.6
external diameter
d_o
outer distance through the centre of the tube from one side to the other in the *gauge length* (3.3)

[SOURCE: ISO 21971:2019, 3.3]

3.7
wall thickness
h
half difference between the *external* (3.6) *and the internal diameters* (3.5) in the *gauge length* (3.3)

[SOURCE: ISO 21971:2019, 3.5, modified – new formulation.]

3.8
initial cross-section area
S_o
cross-section area of the test specimen within the *calibrated length* (3.2) at room temperature before testing

3.9
effective cross-section area
$S_{o,eff}$
area corrected by a factor to account of the presence of a surface layer

3.10
longitudinal deformation
A
dimensional variation in the *gauge length* (3.3) under a tensile force in the load direction

Note 1 to entry: The longitudinal deformation corresponding to the maximum tensile force is denoted as $A_{t,m}$.

3.11
axial tensile strain
ε_{zz}
relative change of the initial *gauge length* (3.3) in the axial (or longitudinal) direction defined as the ratio A/L_o

Note 1 to entry: The tensile strain corresponding to the maximum tensile force is denoted as $\varepsilon_{zz\ t,m}$.

3.12
circumferential strain
$\varepsilon_{\theta\theta}$
relative change of the initial *gauge length* (3.3) in the circumferential direction

3.13
uniaxial tensile force
F
force carried by the test specimen in the axial (or longitudinal) direction at any time during the tensile test

3.14
axial tensile stress
σ_{zz}
uniaxial tensile force (3.13) supported by the test specimen in the axial (or longitudinal) direction at any time in the test divided by the *initial cross-section area* (3.8)

Note 1 to entry: The effective axial tensile stress corresponding to the *uniaxial tensile force* supported by the test specimen in the axial (or longitudinal) direction at any time in the test divided by the *effective cross-section area* (3.9) is denoted as $\sigma_{zz\ eff}$.

3.15
maximum uniaxial tensile force
F_m
highest recorded uniaxial tensile force in a tensile test on the test specimen when tested to failure

3.16
axial tensile strength
$\sigma_{zz\ m}$
ratio of the maximum *uniaxial tensile force* (3.15) to the *initial cross-section area* (3.8)

Note 1 to entry: The effective axial tensile strength corresponding to the ratio of the *maximum uniaxial tensile force* (3.15) to the *effective cross-section area* (3.9) is denoted as $\sigma_{zz\ m,eff}$.

3.17
tensile modulus in the axial (or longitudinal) direction
E_{zz}
slope of the initial linear part of the stress-strain curve at or near the origin

Note 1 to entry: The linear part may not exist or may not start at the origin. The different situations are then described in the Annex A.

Note 2 to entry: The effective tensile modulus corresponding to the slope of the linear part of the stress-strain curve at or near the origin when the effective axial tensile stress is used is denoted as $E_{zz\ eff}$.