SLOVENSKI STANDARD
oSIST prEN ISO 21971:2024

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Fina keramika (sodobna keramika, sodobna tehnična keramika) - Mehanske lastnosti keramičnih kompozitov pri temperaturi okolice in pri zračnem tlaku - Ugotavljanje nateznih lastnosti obroča cevi (ISO 21971:2019)

Fine ceramics (advanced ceramics, advanced technical ceramics) - Mechanical properties of ceramic composites at ambient temperature in air atmospheric pressure - Determination of hoop tensile properties of tubes (ISO 21971:2019)

Hochleistungskeramik - Zugfestigkeitseigenschaften von endlosfaserverstärkten keramischen Verbundrohren bei Umgebungstemperatur (ISO 21971:2019)

Céramiques techniques (céramiques avancées, céramiques techniques avancées) - Propriétés mécaniques des céramiques composites à température ambiante et à pression atmosphérique - Détermination des propriétés en traction circonférentielle de tubes (ISO 21971:2019)

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Mechanical properties of ceramic composites at ambient temperature in air atmospheric pressure — Determination of hoop tensile properties of tubes

Céramiques techniques (céramiques avancées, céramiques techniques avancées) — Propriétés mécaniques des céramiques composites à température ambiante et à pression atmosphérique — Détermination des propriétés en traction circonférentielle de tubes

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 ambient temperature in air atmospheric pressure — Determination of hoop tensile properties of tubes

1 Scope

This document specifies the conditions for the determination of hoop tensile properties of ceramic matrix composite (CMC) tubes with continuous fibre-reinforcement at ambient temperature in air atmospheric pressure. This document is specific to the tubular geometries since fibre architecture and specimen geometry factors in composite tubes are distinctly different from those in flat specimens.

This document provides information on the hoop tensile properties and stress-strain response, such as hoop tensile strength, hoop 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 and/or glass matrix composite tubes with a continuous fibrous-reinforcement: unidirectional (1D filament winding and tape lay-up), bi-directional (2D braid and weave) and tri-directional (xD, with $2 < x < 3$), subjected to an internal pressure.

Values expressed in this document are in accordance with the International System of Units (SI).

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: Micrometers for external measurements — Design and metrological characteristics*

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

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

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 20507 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 http://www.electropedia.org/

3.1
calibrated length
l
part of the test specimen that has uniform and minimum *external diameter* (3.3)

3.2
gauge length
L_0
initial distance between reference points on the test specimen in the *calibrated length* (3.1)

3.3
external diameter
d_o
outer distance through the centre of the tube from one side to the other in the *gauge length* (3.2)

3.4
internal diameter
d_i
inner distance through the centre of the tube from one side to the other in the *gauge length* (3.2)

3.5
wall thickness
h
distance between the *internal* (3.4) and *external diameters* (3.3) in the *gauge length* (3.2)

3.6
hoop tensile strain
$\varepsilon_{\theta\theta}$
relative change in circumferential direction in the *gauge length* (3.2)

3.7
axial strain
ε_{zz}
relative change in the axial (or longitudinal) direction in the *gauge length* (3.2)

3.8
hoop tensile stress
$\sigma_{\theta\theta}$
stress supported by the test specimen in circumferential direction at any time in the test

3.9
burst pressure
P_F
highest recorded internal pressure undergone by the test specimen when tested to failure

3.10
hoop tensile strength
$\sigma_{\theta\theta,m}$
hoop tensile stress (3.8) calculated at the *burst pressure* (3.9)

3.11
proportionality ratio or pseudo-elastic modulus in the circumferential direction
$EP_{\theta\theta}$
slope of the initial linear section of the stress-strain curve

Note 1 to entry: Examination of the stress-strain curves for ceramic matrix composites allows definition in the following cases:

a) Material with an initial linear domain in the stress-strain curve.

The proportionality ratio or pseudo-elastic modulus is termed the elastic modulus in the circumferential direction, $E_{\theta\theta}$, in the single case where the linearity starts near the origin.

b) Material with no-linear section in the stress-strain curve.

In this case only stress-strain couples can be fixed.