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# SS-EN ISO 20504:2016

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SWEDISH STANDARDS INSTITUTE

## Fine ceramics
## (advanced ceramics, advanced technical ceramics) –
## Test method for compressive behaviour of continuous fibre-reinforced composites at room temperature
## (ISO 20504:2006)

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Europastandarden EN ISO 20504:2016 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 20504:2016.

Denna standard ersätter SS-EN 658-2, utgåva 1.

The European Standard EN ISO 20504:2016 has the status of a Swedish Standard. This document contains the official English version of EN ISO 20504:2016.

This standard supersedes the Swedish Standard SS-EN 658-2, edition 1.



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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN ISO 20504

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Supersedes EN 658-2:2002

English Version

## Fine ceramics (advanced ceramics, advanced technical ceramics) - Test method for compressive behaviour of continuous fibre-reinforced composites at room temperature (ISO 20504:2006)

Céramiques techniques - Méthode d'essai de résistance à la compression des composites renforcés de fibres continues à température ambiante (ISO 20504:2006)

Hochleistungskeramik - Bestimmung der Eigenschaften unter Druck von endlosfaserverstärkten Verbundwerkstoffen bei Raumtemperatur (ISO 20504:2006)

This European Standard was approved by CEN on 25 March 2016.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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 CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**



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# European foreword

The text of ISO 20504:2006 has been prepared by Technical Committee ISO/TC 206 “Fine ceramics” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 20504:2016 by Technical Committee CEN/TC 184 “Advanced technical ceramics” the secretariat of which is held by DIN.

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 October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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.

This document supersedes EN 658-2:2002.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**Endorsement notice**

The text of ISO 20504:2006 has been approved by CEN as EN ISO 20504:2016 without any modification.

# Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for compressive behaviour of continuous fibre-reinforced composites at room temperature

## 1 Scope

This International Standard describes procedures for determination of the compressive behaviour of ceramic matrix composite materials with continuous fibre reinforcement at room temperature. This method applies to all ceramic matrix composites with a continuous fibre reinforcement, uni-directional (1D), bi-directional (2D) and tri-directional ($x$D, with $2 < x \leqslant 3$), tested along one principal axis of reinforcement. This method may also be applied to carbon-fibre-reinforced carbon matrix composites (also known as: carbon/carbon or C/C). Two cases of testing are distinguished: compression between platens and compression using grips.

## 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.

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 3611, *Micrometer callipers for external measurements*

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

ISO 14126, *Fibre-reinforced plastic composites — Determination of compressive properties in the in-plane direction*

ASTM E1012, *Standard Practice for Verification of Test Frame and Specimen Alignment Under Tensile and Compressive Axial Force Application*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**gauge section**
part of the test specimen which has uniform and minimum cross-sectional area

**3.2**
**gauge section length**
$l$
length of the gauge section

**3.3**
**initial gauge length**
$L_o$
initial distance between reference points on the test specimen in the gauge section before initiation of the test

**3.4**
**final gauge length**
$L_f$
final distance between reference points on the test specimen in the gauge section at the completion of the test

**3.5**
**initial cross-sectional area**
$A_o$
initial area of the gauge section's cross-section

**3.6**
**longitudinal deformation**
$\Delta L$
change (contraction) of the initial gauge due to the application of a uniaxial compressive force

NOTE The longitudinal deformation corresponding to the maximum force should be denoted as $\Delta L_{c,m}$.

**3.7**
**compressive strain**
$\varepsilon$
relative change in the gauge length defined as the ratio $\Delta L/L_o$

NOTE The compressive strain corresponding to the maximum force is denoted as $\varepsilon_{c,m}$.

**3.8**
**compressive force**
$F_c$
uniaxial compressive force applied to a test specimen

**3.9**
**maximum compressive force**
$F_{c,m}$
greatest uniaxial compressive force applied to a test specimen when tested to failure

**3.10**
**compressive stress**
$\sigma$
compressive force supported by the test specimen at any time in the test divided by the initial cross-sectional area such that $\sigma = F_c/A_o$

**3.11**
**compressive strength**
$S_{c,m}$
greatest compressive stress applied to a test specimen when tested to failure

**3.12**
**proportionality ratio or pseudo-elastic modulus**
$E_p$
slope of the linear region of the stress-strain curve, if any

NOTE Examination of the stress-strain curves for ceramic matrix composites allows definition of the following cases:

— Material with a linear region in the stress-strain curve.

For ceramic matrix composites that have a mechanical behaviour characterised by a linear region, the proportionality ratio $E_p$ is defined as:

$$E_p(\sigma_1, \sigma_2) = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - \varepsilon_1} \quad (1)$$

where ($\varepsilon_1$, $\sigma_1$) and ($\varepsilon_2$, $\sigma_2$) lie near the lower and the upper limits of the linear region of the stress-strain curve (see Figures A.1 and A.2).

— Material with non-linear region in the stress-strain curve. In this case only, stress-strain couples can be determined at specified stresses or specified strains.

**3.13**
**elastic modulus**
$E$
proportionality ratio or pseudo-elastic modulus, in the special case where the linearity starts near the origin

See Figure A.2.

**3.14**
**axial strain**
average of the longitudinal strain measured at the surface of the test specimen at specified locations

See Annex B.

**3.15**
**bending strain**
difference between the longitudinal strain at a given longitudinal location on the test specimen surface and the axial strain at the same location

See Annex B.

**3.16**
**buckling force**
critical axially applied force at which an initially straight column assumes a curved shape

**3.17**
**critical buckling stress**
critical axial compressive stress at which an initially straight column assumes a curved shape

# 4 Principle

A test specimen of specified dimensions is loaded in compression. The compression test is usually performed at a constant cross-head displacement rate or at a constant deformation rate.

NOTE Constant force rate is only allowed in the case of linear stress-strain behaviour up to failure.

For cross-head displacement tests, a constant rate is recommended when the test is conducted to failure.

The force and longitudinal deformation are measured and recorded simultaneously.