International Standard

ISO 14544

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

Céramiques techniques — Propriétés mécaniques des composites à matrice céramique à haute température — Détermination des caractéristiques en compression

Second edition
2025-01

Reference number
ISO 14544:2025(en)

© ISO 2025



COPYRIGHT PROTECTED DOCUMENT

© ISO 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

Foreword ..... **v**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Principle **3**

5 Apparatus **4**
5.1 Test machine 4
5.2 Load train 4
5.3 Gastight test chamber 4
5.4 Set-up for heating 5
5.5 Strain measurement 5
5.5.1 General 5
5.5.2 Strain gauges 5
5.5.3 Extensometer 5
5.6 Temperature measurement devices 6
5.7 Data recording system 6
5.8 Dimension measuring devices 7

6 Test specimens **7**
6.1 General 7
6.2 Compression between platens 7
6.3 Test specimen used with grips 9

7 Test specimen preparation **11**
7.1 Machining and preparation 11
7.2 Number of test specimens 12

8 Test procedures **12**
8.1 Test set-up: temperature considerations 12
8.1.1 General 12
8.1.2 Controlled-temperature zone 12
8.1.3 Temperature calibration 12
8.2 Test set-up: other considerations 13
8.2.1 Displacement rate 13
8.2.2 Measurement of test-specimen dimensions 13
8.2.3 Buckling 13
8.3 Testing technique 14
8.3.1 Specimen mounting 14
8.3.2 Setting of extensometer 14
8.3.3 Setting of inert atmosphere 14
8.3.4 Heating of test specimen 14
8.3.5 Measurements 15
8.4 Test validity 15

9 Calculation of results **15**
9.1 Test specimen origin 15
9.2 Compressive strength 15
9.3 Strain at maximum compressive force 16
9.4 Compressive modulus 16
9.4.1 Calculation of compressive modulus 16
9.4.2 Calculation of compressive modulus with linear behaviour at the origin 17
9.4.3 Calculation of compressive modulus with non-linear behaviour 17

10 Test report **17**

11 Uncertainties **18**

© ISO 2025 – All rights reserved

Annex A (informative) **Illustration of compressive modulus** **19**

Annex B (informative) **Calibration method of the test temperature using a cartographic specimen equipped with thermocouples** **22**

Bibliography **27**

© ISO 2025 – All rights reserved

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 184, *Advanced technical ceramics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 14544:2013), which has been technically revised.

The main changes are as follows:

— alignment of the terms and definition with the vocabulary standard ISO 20507;

— addition of illustration of compressive modulus in Annex A;

— addition of a calibration method of the test temperature by using a cartographic specimen equipped with thermocouples in Annex B.

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.

© ISO 2025 – All rights reserved

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

1 Scope

This document specifies procedures for determination of the compressive behaviour of ceramic matrix composite materials with continuous fibre reinforcement at elevated temperature in air, vacuum and inert gas atmospheres. This document applies to all ceramic matrix composites with a continuous fibre reinforcement, uni-directional (1D), bidirectional (2D) and multi-directional (*x*D, with $x > 2$), tested along one principal axis of reinforcement or off axis conditions for 2D and *x*D materials. This document also applies 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 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 19634, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Ceramic composites — Notations and symbols*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminology 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

© ISO 2025 – All rights reserved