Fibre-reinforced plastic composites - Determination of compressive properties in the in-plane direction (ISO 14126:2023)

EESTI STANDARDIMIS- JA AKREDITEERIMISKESKUS
ESTONIAN CENTRE FOR STANDARDISATION AND ACCREDITATION

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 14126:2023 sisaldab Euroopa standardi EN ISO 14126:2023 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 14126:2023 consists of the English text of the European standard EN ISO 14126:2023.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 25.10.2023.	Date of Availability of the European standard is 25.10.2023.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 83.120

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 14126

October 2023

ICS 83.120

Supersedes EN ISO 14126:1999, EN ISO 14126:1999/AC:2002

English Version

Fibre-reinforced plastic composites - Determination of compressive properties in the in-plane direction (ISO 14126:2023)

Composites plastiques renforcés de fibres - Détermination des caractéristiques en compression dans le plan (ISO 14126:2023)

Faserverstärkte Kunststoffe - Bestimmung der Druckeigenschaften in der Laminatebene (ISO 14126:2023)

This European Standard was approved by CEN on 5 October 2023.

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.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN ISO 14126:2023 E

European foreword

This document (EN ISO 14126:2023) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 “Plastics” the secretariat of which is held by SIS.

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 April 2024, and conflicting national standards shall be withdrawn at the latest by April 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 14126:1999, EN ISO 14126:1999/AC:2002.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO 14126:2023 has been approved by CEN as EN ISO 14126:2023 without any modification.

Contents

Page

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 Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 14126:1999), which has been technically revised.

The main changes are as follows:

— a new normative Annex A, alignment of specimen and loading train, has been added and subsequent annexes have been renumbered;

— Annex B, specimen preparation, is now normative to emphasise the importance of producing good quality specimens;

— two new informative Annexes F and G have been added.

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.

Introduction

This document, originally published in 1999, was based on ISO 8515[1] with the scope extended from glass-fibre reinforcement to include all fibre-reinforced plastic composites, such as composites based on carbon and aramid fibres. Other source documents consulted included ASTM D 3410[2], SACMA SRM1[3], prEN 2850[4], CRAG 400[5], DIN 65380[6] and JIS K7076[7]. Several different types of anti-buckling fixtures/loading jigs, different materials and different specimen sizes are covered by these source documents, although all are parallel-sided coupons. New or modified geometry support jigs are still being developed, for example in JIS K7018[8].

This document harmonizes and rationalizes the current situation by:

a) concentrating on the quality of the test by limiting the maximum bending strain allowable (i.e. 10 % between 10 % and 90 % of the maximum load, as recommended by ASTM), so that an axial-load case can be assumed;

b) standardizing on two related specimen designs, one principally for aerospace type unidirectional pre-impregnated materials (i.e. Type A) and one for other materials/formats (i.e. Types B1/B2). The chosen specimen design can be used with different loading fixtures;

c) defining acceptable failure criteria (e.g. avoiding within grip failures);

d) including an equation for determining the specimen minimum thickness to avoid Euler buckling proposed by ASTM for harmonization purposes (taken from ASTM D 3410[2] in a modified form);

e) allowing any design of support/loading fixture to be used that meets the above bending requirements, using different principles of loading (i.e. essentially shear and combined loading);

f) ensuring that the test specimen and loading/support fixture are well aligned (see Annex A);

g) concentrating on the quality of specimen preparation (see Annex B);

h) including guidance on the use of digital image correlation (DIC) for strain and bending measurements (see Annex G);

NOTE 1 Compression properties measured in the through-thickness direction (direction 3 in Figure 1) are covered by ISO 20975-1[9].

NOTE 2 Compression properties of rigid plastics having only unaligned short (<7,5 mm) fibres or no fibre content [rather than long (>7,5 mm) discontinuous or continuous fibres] is covered by ISO 604[10].

Fibre-reinforced plastic composites — Determination of compressive properties in the in-plane direction

1 Scope

1.1 This document specifies methods for determining the compressive properties, in directions parallel to the plane of lamination, of fibre-reinforced plastic composites, based on thermosetting or thermoplastic matrices. The compressive properties are of interest for specifications and quality-control purposes. The test specimens are machined from a flat test plate, or from suitable finished or semi-finished products.

1.2 Two loading methods and two types of specimen are described.

The loading methods are:

— Method 1: provides shear loading of the specimen (gauge length unsupported)

— Method 2: provides combined loading of the specimen (gauge length unsupported)

NOTE For tabbed specimens loaded using method 2, load is transferred through a combination of end-loading and shear-loading through the tabs.

The specimen designs are:

— Type A specimen: rectangular cross-section, fixed thickness, end-tabbed (mainly for aerospace style preimpregnates (~ 0,125 mm ply thickness)

— Type B specimen: rectangular cross-section, range of thicknesses, untabbed or end-tabbed, two specimen sizes are available (B1 and B2).

The Type A specimen is used for unidirectionally or biaxially reinforced materials tested in the fibre direction, where the fibres are normally either aligned continuous or aligned long (>7,5 mm) discontinuous. The Type B1 and B2 specimens are used for multi-directional aligned; mat, fabric and other multi-directionally reinforced materials where the fibre structure is more complex and/or coarser.

1.3 This document gives criteria for checking that the combination of test method and specimen design result in valid failures. It is noted that alternative test method/specimen combinations will not necessarily give the same result.

1.4 The methods specify required dimensions for the specimen. Tests carried out on specimens of other dimensions, or on specimens that are prepared under different conditions, can produce results that are not comparable. Other factors, such as the speed of testing, the support fixture used and the conditioning of the specimens, can influence the results.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 1268 (all parts), *Fibre-reinforced plastics — Methods of producing test plate*

ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

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 23788, *Metallic materials — Verification of the alignment of fatigue testing machines*

ASTM E 1012, *Standard practice for verification of testing 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.

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
compressive stress
σ_c
compressive force experienced by the test specimen, at a particular time, divided by the initial cross-sectional area of the parallel-sided portion of the specimen

Note 1 to entry: It is expressed in megapascals.

3.2
compressive strength
compressive failure stress
σ_{cM}
maximum *compressive stress* (3.1) sustained by the specimen

Note 1 to entry: It is expressed in megapascals.

3.3
compressive strain
ε_c
decrease in length per unit length of the original gauge length

Note 1 to entry: It is expressed as a dimensionless ratio or in percent.

3.4
compressive failure strain
ε_{cM}
longitudinal compressive strain at the compressive failure stress

Note 1 to entry: It is expressed as a dimensionless ratio or in percent.

3.5
modulus of elasticity in compression
chord modulus
E_c
stress difference (σ" minus σ') divided by the corresponding strain difference (Ɛ" (= 0,002 5) minus Ɛ' (= 0,000 5))

Note 1 to entry: It is expressed in megapascals.

Note 2 to entry: See 10.2.