SLOVENSKI STANDARD
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Polimerni materiali - Ugotavljanje nateznih lastnosti - 5. del: Preskusni pogoji za enostransko z vlakni ojačene polimerne kompozite (ISO/DIS 527-5:2020)

Plastics - Determination of tensile properties - Part 5: Test conditions for unidirectional fibre-reinforced plastic composites (ISO/DIS 527-5:2020)

Kunststoffe - Bestimmung der Zugeigenschaften - Teil 5: Prüfbedingungen für unidirektional faserverstärkte Kunststoffverbundwerkstoffe (ISO/DIS 527-5:2020)

Plastiques - Détermination des propriétés en traction - Partie 5 : Conditions d'essai pour les composites plastiques renforcés de fibres unidirectionnelles (ISO/DIS 527-5:2020)

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Plastics — Determination of tensile properties —

Part 5: Test conditions for unidirectional fibre-reinforced plastic composites

Plastiques — Détermination des propriétés en traction —

Partie 5: Conditions d'essai pour les composites plastiques renforcés de fibres unidirectionnelles

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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).

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 61, Plastics, Subcommittee SC 13, Composites and reinforcement fibres.

This third edition cancels and replaces the second edition (ISO 527-5:2009), of which it constitutes a revision. The main changes are as follows:

— Adjustment of gripping force or pressure (e.g. via torque or manometer depending on gripping system used)

— Implementation of annex C (Unbonded tabs or gripping condition without tabs using fine grip face),

Consideration is being given to the use of Type 4 specimen in ISO 527 Part 4 in a future revision following an international interlaboratory round robin on testing unidirectional materials in the 90º direction.

A list of all parts in the ISO 527 series can be found on the ISO website.

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.

Plastics — Determination of tensile properties —

Part 5: Test conditions for unidirectional fibre-reinforced plastic composites

1 Scope

1.1 This part of ISO 527 specifies the test conditions for the determination of the tensile properties of unidirectional fibre-reinforced plastic composites, based upon the general principles given in Part 1.

1.2 The methods are used to investigate the tensile behaviour of the test specimens and for determining the tensile strength, tensile modulus, Poisson's ratios and other aspects of the tensile stress/strain relationship under the conditions defined.

1.3 The test method is suitable for all polymer matrix systems reinforced with unidirectional fibres and which meet the requirements, including failure mode, set out in this part of ISO 527.

The method is suitable for composites with either thermoplastic or thermosetting matrices, including preimpregnated materials (prepregs). The reinforcements covered include carbon fibres, glass fibres, aramid fibres and other similar fibres. The reinforcement geometries covered include unidirectional (i.e. completely aligned) fibres and rovings and unidirectional fabrics and tapes.

The method is not normally suitable for multidirectional materials composed of several unidirectional layers at different angles (see ISO 527 4).

1.4 The method is performed using one of two different types of test specimen, depending on the direction of the applied stress relative to the fibre direction (see Clause 6) and depending on the application of end tabs..

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 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

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

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

3 Terms and definitions

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

3.1
gauge length
See ISO 527-1, Subclause 3.1.

3.2
thickness
h
See ISO 527-1, subclause 3.2

3.3
width
b
See ISO 527-1, subclause 3.3

3.4
speed of testing
See ISO 527-1, Subclause 3.5.

3.5
tensile stress
σ (engineering)
See ISO 527-1, Subclause 4.3, except that σ for type A specimens is defined as σ_1 and for type B specimens as σ_2 (see Clause 6 for details of type A and B specimens).

3.5.1
tensile strength
σ_M
See ISO 527-1, Subclause 4.3.3, except that σ_M for type A specimens is defined as σ_{M1} and for type B specimens as σ_{M2}.

3.6
tensile strain
ε
increase in length per unit length of the original gauge length

Note 1 to entry: For type A specimens, ε is defined as ε_1 and for type B specimens as ε_2.

Note 2 to entry: It is expressed as a dimensionless ratio or in percent.

3.7
tensile strain at tensile strength
tensile failure strain
ε_M
tensile strain at the point corresponding to the tensile strength of the specimen

Note 1 to entry: For type A specimens, ε_M is defined as ε_{M1} and for type B specimens as ε_{M2}.

Note 2 to entry: It is expressed as a dimensionless ratio or in percent.

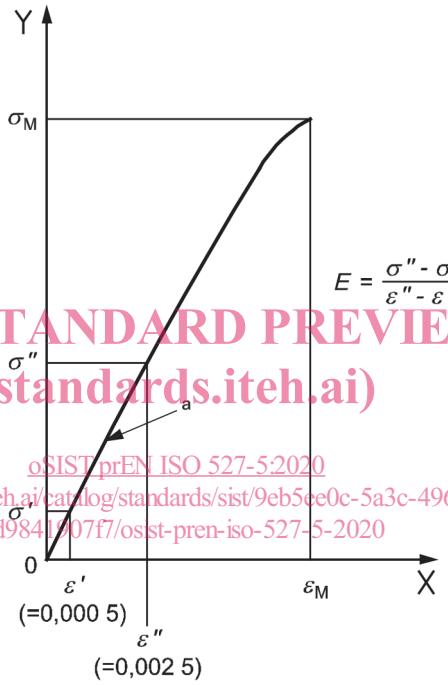
3.8
modulus of elasticity in tension
Young's modulus
E
See ISO 527-1, Subclause 4.6, except that E for type A specimens is defined as E_1 and for type B specimens as E_2.

Note 1 to entry: The strain values used are as given in ISO 527-1, Subclause 3.9, i.e. $\varepsilon' = 0{,}000\ 5$ and $\varepsilon'' = 0{,}002\ 5$ (see Figure 1), unless alternative values are given in the material or technical specifications.

3.9
Poisson's ratio
μ
See ISO 527-1, Subclause 3.10, except that for type A specimens μ_b is defined as μ_{12} and μ_h as μ_{13}, using the coordinates shown in Figure 2, and for type B specimens μ_b is defined as μ_{21} and μ_h as μ_{23}.

3.10
specimen coordinate axes
coordinate axes for the material under test, as shown in Figure 2, the direction parallel to the fibres being defined as the "1"-direction and the direction perpendicular to them (in the plane of the fibres) as the "2"-direction

Note 1 to entry: The "1"-direction is also referred to as the 0° or longitudinal direction and the "2"-direction as the 90° or transverse direction.



Key

X strain, ε
Y stress, σ
[a] Slope E.

Figure 1 — Stress-strain curve

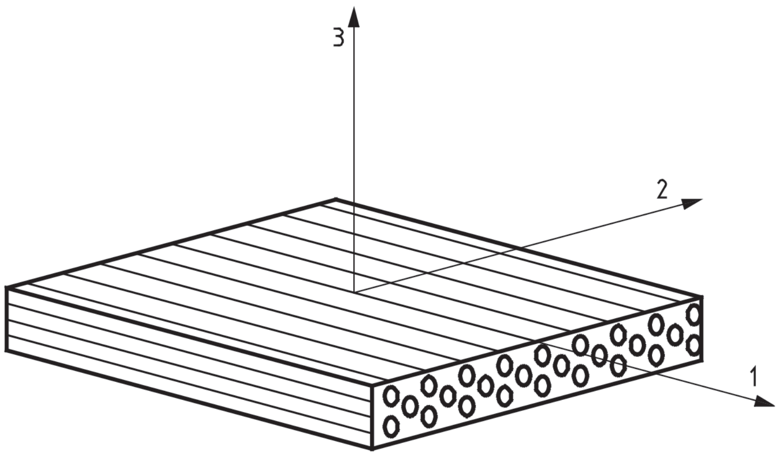


Figure 2 — Unidirectionally reinforced plastic composite showing axes of symmetry

4 Principle

See ISO 527-1, Clause 4.

5 Apparatus

See ISO 527-1, Clause 5, except for the following:

The micrometre or its equivalent (see ISO 16012) shall read to 0,01 mm or better. It shall have a suitable-size ball ended anvil if used on irregular surfaces and a flat anvil if used on flat, smooth (e.g. machined) surfaces.

Care shall be exercised to ensure that the pressure exerted by the grips (see ISO 527-1, subclause 5.1.3) is only sufficient to prevent the specimen slipping in the grip when loaded to failure. Excessive grip pressure may cause crushing of the specimen due to the low transverse strength of these materials. Hydraulic grips which can be set at a constant grip pressure are preferred.

If strain gauges bonded to the specimen are used, the errors produced by the transverse effect on the transverse gauge will generally be much larger for anisotropic composites than for metals, which are isotropic. Accurate measurement of Poisson's ratio requires correction for this effect.

NOTE It is recommended that alignment of the specimen and loading train be checked as described in Annex B.

6 Test specimens

6.1 Shape and dimensions

6.1.1 General

Two types of test specimen are specified for use with this part of ISO 527, depending on the direction of test relative to the fibre direction and depending on the application of end tabs, as detailed and illustrated in Figure 3 and 4. Type A is used for testing in direction parallel to the fibres (with end tabs). Type B (with end tabs). Type A and B can also be used with unbonded tabs or gripping condition without tabs using fine grip face (See Annex C).

To decide whether to use specimen with or without bonded tabs, first carry out tests without using bonded tabs and, if the tests are not possible or not satisfactory, i.e. if almost all specimens break in the grips (see clause 7), perform test with bonded end tabs on the specimens.

In the following paragraphs specimen thicknesses are defined. If materials can not be manufactured in that thickness because of unavoidable reasons like a higher area weight or manufacturing from pultrusion in a different thickness the nearest possible thickness shall be chosen.