SIST

SLOVENSKI STANDARD
SIST EN ISO 527-1:2000

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Polimerni materiali - Določanje nateznih lastnosti - 1. del: Splošna načela (ISO 527-1:1993 vključno s popravkom 1:1994)

Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)

Kunststoffe - Bestimmung der Zugeigenschaften - Teil 1: Allgemeine Grundsätze (ISO 527-1:1993 einschließlich Corr 1:1994)

Plastiques - Détermination des propriétés en traction - Partie 1: Principes généraux (ISO 527-1:1993 inclut Corr 1::1994)

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Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)

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CEN

European Committee for Standardization
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Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

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Foreword

The text of the International Standard from Technical Committee ISO/TC 61 "Plastics" of the International Organization for Standardization (ISO) has been taken over as a European Standard by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN .

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of an identical text or by endorsement, at the latest by August 1996, and conflicting national standards shall be withdrawn at the latest by August 1996.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 527-1:1993 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO 527-1

First edition
1993-06-15

Plastics — Determination of tensile properties —

Part 1: General principles

Plastiques — Détermination des propriétés en traction —

Partie 1: Principes généraux

Reference number
ISO 527-1:1993(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 527-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 2, *Mechanical properties*.

Together with the other parts of ISO 527, it cancels and replaces ISO Recommendation R 527:1966, which has been technically revised.

ISO 527 consists of the following parts, under the general title *Plastics — Determination of tensile properties*:

— *Part 1: General principles*

— *Part 2: Test conditions for moulding and extrusion plastics*

— *Part 3: Test conditions for sheet and film*

— *Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

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

Annex A of this part of ISO 527 is for information only.

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Plastics — Determination of tensile properties —

Part 1:
General principles

1 Scope

1.1 This part of ISO 527 specifies the general principles for determining the tensile properties of plastics and plastic composites under defined conditions.

Several different types of test specimen are defined to suit different types of material which are detailed in subsequent parts of ISO 527.

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

1.3 The methods are selectively suitable for use with the following range of materials:

— rigid and semirigid thermoplastics moulding and extrusion materials, including filled and reinforced compounds in addition to unfilled types; rigid and semirigid thermoplastics sheets and films;

— rigid and semirigid thermosetting moulding materials, including filled and reinforced compounds; rigid and semirigid thermosetting sheets, including laminates;

— fibre-reinforced thermoset and thermoplastics composites incorporating unidirectional or non-unidirectional reinforcements such as mat, woven fabrics, woven rovings, chopped strands, combination and hybrid reinforcements, rovings and milled fibres; sheets made from pre-impregnated materials (prepregs);

— thermotropic liquid crystal polymers.

The methods are not normally suitable for use with rigid cellular materials or sandwich structures containing cellular material.

1.4 The methods are applied using specimens which may be either moulded to the chosen dimensions or machined, cut or punched from finished and semifinished products such as mouldings, laminates, films and extruded or cast sheet. In some cases a multipurpose test specimen (see ISO 3167:1993, *Plastics — Preparation and use of multipurpose test specimens*), may be used.

1.5 The methods specify preferred dimensions for the test specimens. Tests which are carried out on specimens of different dimensions, or on specimens which are prepared under different conditions, may produce results which are not comparable. Other factors, such as the speed of testing and the conditioning of the specimens, can also influence the results. Consequently, when comparative data are required, these factors must be carefully controlled and recorded.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 527. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 527 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 2602:1980, *Statistical interpretation of test re-*

sults — Estimation of the mean — Confidence interval.

ISO 5893:1985, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

3 Principle

The test specimen is extended along its major longitudinal axis at constant speed until the specimen fractures or until the stress (load) or the strain (elongation) reaches some predetermined value. During this procedure the load sustained by the specimen and the elongation are measured.

4 Definitions

For the purposes of this part of ISO 527, the following definitions apply.

4.1 gauge length, L_0: Initial distance between the gauge marks on the central part of the test specimen; see figures of the test specimens in the relevant part of ISO 527.

It is expressed in millimetres (mm).

4.2 speed of testing, v: Rate of separation of the grips of the testing machine during the test.

It is expressed in millimetres per minute (mm/min).

4.3 tensile stress, σ (engineering): Tensile force per unit area of the original cross-section within the gauge length, carried by the test specimen at any given moment.

It is expressed in megapascals (MPa) [see 10.1, equation (3)].

4.3.1 tensile stress at yield; yield stress, σ_y: First stress at which an increase in strain occurs without an increase in stress.

It is expressed in megapascals (MPa).

It may be less than the maximum attainable stress (see figure 1, curves b and c).

4.3.2 tensile stress at break, σ_B: The tensile stress at which the test specimen ruptures (see figure 1).

It is expressed in megapascals (MPa).

4.3.3 tensile strength, σ_M: Maximum tensile stress sustained by the test specimen during a tensile test (see figure 1).

It is expressed in megapascals (MPa).

4.3.4 tensile stress at x % strain (see 4.4), **σ_x:** Stress at which the strain reaches the specified value x expressed in percentage.

It is expressed in megapascals (MPa).

It may be measured for example if the stress/strain curve does not exhibit a yield point (see figure 1, curve d). In this case, x shall be taken from the relevant product standard or agreed upon by the interested parties. However, x must be lower than the strain corresponding to the tensile strength, in any case.

4.4 tensile strain, ε: Increase in length per unit original length of the gauge.

It is expressed as a dimensionless ratio, or in percentage (%) [see 10.2, equations (4) and (5)].

It is used for strains up to yield point (see 4.3.1); for strains beyond yield point see 4.5.

4.4.1 tensile strain at yield, ε_y: Tensile strain at the yield stress (see 4.3.1 and figure 1, curves b and c).

It is expressed as a dimensionless ratio, or in percentage (%).

4.4.2 tensile strain at break, ε_B: Tensile strain at the tensile stress at break (see 4.3.2), if it breaks without yielding (see figure 1, curves a and d).

It is expressed as a dimensionless ratio, or in percentage (%).

For breaking after yielding, see 4.5.1.

4.4.3 tensile strain at tensile strength, ε_M: Tensile strain at the point corresponding to tensile strength (see 4.3.3), if this occurs without or at yielding (see figure 1, curves a and d).

It is expressed as a dimensionless ratio or in percentage (%).

For strength values higher than the yield stress, see 4.5.2.

4.5 nominal tensile strain, ε_t: Increase in length per unit original length of the distance between grips (grip separation).

It is expressed as a dimensionless ratio, or in percentage (%) [see 10.2, equations (6) and (7)].

It is used for strains beyond yield point (see 4.3.1). For strains up to yield point, see 4.4. It represents the total relative elongation which takes place along the free length of the test specimen.

4.5.1 nominal tensile strain at break, ε_{tB}: Nominal tensile strain at the tensile stress at break (see 4.3.2), if the specimen breaks after yielding (see figure 1, curves b and c).

It is expressed as a dimensionless ratio, or in percentage (%).

For breaking without yielding, see 4.4.2.

4.5.2 nominal tensile strain at tensile strength, ε_{tM}**:** Nominal tensile strain at tensile strength (see 4.3.3), if this occurs after yielding (see figure 1, curve b).

It is expressed as a dimensionless ratio, or in percentage (%).

For strength values without or at yielding, see 4.4.3.

4.6 modulus of elasticity in tension; Young's modulus, E_t**:** Ratio of the stress difference σ_2 minus σ_1 to the corresponding strain difference values $\varepsilon_2 = 0{,}002\ 5$ minus $\varepsilon_1 = 0{,}000\ 5$ (see figure 1, curve d and 10.3, equation (8)].

It is expressed in megapascals, (MPa).

This definition does not apply to films and rubber.

NOTE 1 With computer-aided equipment, the determination of the modulus E_t using two distinct stress/strain points can be replaced by a linear regression procedure applied on the part of the curve between these mentioned points.

4.7 Poisson's ratio, μ**:** Negative ratio of the tensile strain ε_n, in one of the two axes normal to the direction of pull, to the corresponding strain ε in the direction of pull, within the initial linear portion of the longitudinal versus normal strain curve.

It is expressed as a dimensionless ratio.

Poisson's ratio is indicated as μ_b (width direction) or μ_h (thickness direction) according to the relevant axis. Poisson's ratio is preferentially used for long-fibre-reinforced materials.

5 Apparatus

5.1 Testing machine

5.1.1 General

The machine shall comply with ISO 5893, and meet the specifications given in 5.1.2 to 5.1.5, as follows.

5.1.2 Speeds of testing

The tensile-testing machine shall be capable of maintaining the speeds of testing (see 4.2) as specified in table 1.

Table 1 — Recommended testing speeds

Speed mm/min	Tolerance %
1	± 20 [1)]
2	± 20 [1)]
5	± 20
10	± 20
20	± 10
50	± 10
100	± 10
200	± 10
500	± 10

1) These tolerances are smaller than those indicated in ISO 5893.

5.1.3 Grips

Grips for holding the test specimen shall be attached to the machine so that the major axis of the test specimen coincides with the direction of pull through the centreline of the grip assembly. This can be achieved, for example, by using centring pins in the grips. The test specimen shall be held such that slip relative to the grips is prevented as far as possible and this shall preferably be effected with the type of grip that maintains or increases pressure on the test specimen as the force applied to the test specimen increases. The clamping system shall not cause premature fracture at the grips.

5.1.4 Load indicator

The load indicator shall incorporate a mechanism capable of showing the total tensile load carried by the test specimen when held by the grips. The mechanism shall be essentially free from inertia lag at the specified rate of testing, and shall indicate the load with an accuracy of at least 1 % of the actual value. Attention is drawn to ISO 5893.

5.1.5 Extensometer

The extensometer shall comply with ISO 5893. It shall be capable of determining the relative change in the gauge length on the test specimen at any time during the test. It is desirable, but not essential, that this instrument should automatically record this change. The instrument shall be essentially free from inertia lag at the specified speed of testing, and shall be capable of measuring the change of gauge length with an accuracy of 1 % of the relevant value or better. This corresponds to ± 1 µm for the measurement of the modulus, based on a gauge length of 50 mm.