SIST

SLOVENSKI STANDARD
SIST EN ISO 178:2000

01-maj-2000

Polimerni materiali - Doloļ anje upogibnih lastnosti (ISO 178:1993)

Plastics - Determination of flexural properties (ISO 178:1993)

Kunststoffe - Bestimmung der Biegeeigenschaften (ISO 178:1993)

Plastiques - Détermination des propriétés en flexion (ISO 178:1993)

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ICS:

83.080.01	Polimerni materiali na splošno	Plastics in general

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English version

Plastics - Determination of flexural properties (ISO 178:1993)

Plastiques - Détermination des propriétés en flexion (ISO 178:1993)

Kunststoffe - Bestimmung der Biegeeigenschaften (ISO 178:1993)

This European Standard was approved by CEN on 1994-12-14. 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 Central Secretariat or to any CEN member.

The European Standards exist 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 Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

Ref. No. EN ISO 178:1996 E

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 an European Standard by Technical Committee CEN/TC 249 "Plastcs", 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of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June of 1997.

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 178:1993 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO 178

Third edition
1993-05-15

Plastics — Determination of flexural properties

Plastiques — Détermination des propriétés en flexion

Reference number
ISO 178:1993(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 178 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 2, *Mechanical properties*.

This third edition cancels and replaces the second edition (ISO 178:1975), which has been improved in the following ways:

— normative references have been added especially for specimen preparation and the use of multipurpose test specimens complying with ISO 3167;

— a definition of modulus is given;

— one strain rate only is recommended;

— designation of quantities has been harmonized with those of other International Standards for testing plastics, in accordance with ISO 31.

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Plastics — Determination of flexural properties

1 Scope

1.1 This International Standard specifies a method for determining the flexural properties of plastics under defined conditions. A standard test specimen is defined, but parameters are included for alternative specimen sizes for use where appropriate. A range of testing speeds is included.

1.2 The method is used to investigate the flexural behaviour of the test specimens and for determining the flexural strength, flexural modulus and other aspects of the flexural stress/strain relationship under the conditions defined. It applies to a freely supported beam, loaded at midspan (three-point loading test).

1.3 The method is suitable for use with the following range of materials:

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

— thermosetting moulding materials, including filled and reinforced compounds; 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 method is not normally suitable for use with rigid cellular materials and sandwich structures containing cellular material.

NOTE 1 For certain types of textile-fibre-reinforced plastics, a four-point bending test is preferred. This is currently under consideration in ISO.

1.4 The method is performed using specimens which may be either moulded to the chosen dimensions, machined from the central portion of a standard multi-purpose test specimen (see ISO 3167) or machined from finished and semi-finished products such as mouldings, laminates and extruded or cast sheet.

1.5 The method specifies preferred dimensions for the test specimen. 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.

1.6 Flexural properties can only be used for engineering design purposes for materials with linear stress/strain behaviour. For non-linear material behaviour the flexural properties are only nominal. The bending test should preferentially be used with brittle materials, for which tensile tests are difficult.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 293:1986, *Plastics — Compression moulding test specimens of thermoplastic materials.*

ISO 294:—[1], *Plastics — Injection moulding of test specimens of thermoplastic materials.*

ISO 295:1991, *Plastics — Compression moulding of test specimens of thermosetting materials.*

ISO 1209-1:1990, *Cellular plastics, rigid — Flexural tests — Part 1: Bending test.*

ISO 1209-2:1990, *Cellular plastics, rigid — Flexural tests — Part 2: Determination of flexural properties.*

ISO 1268:1974, *Plastics — Preparation of glass fibre reinforced, resin bonded, low-pressure laminated plates or panels for test purposes.*

ISO 2557-1:1989, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified maximum reversion — Part 1: Bars.*

ISO 2557-2:1986, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified reversion — Part 2: Plates.*

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 2818:—[2], *Plastics — Preparation of test specimens by machining.*

ISO 3167:—[3], *Plastics — Multipurpose test specimens.*

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 speed of testing, v**:** Rate of relative movement between the supports and the striking edge, expressed in millimetres per minute (mm/min).

3.2 flexural stress, σ_f**:** Nominal stress of the outer surface of the test specimen at midspan.

It is calculated according to the relationship given in 9.1, equation (3), and is expressed in megapascals (MPa).

3.3 flexural stress at break, σ_{fB}**:** Flexural stress at break of the test specimen (see figure 1, curves a and b).

It is expressed in megapascals (MPa).

3.4 flexural strength, σ_{fM}**:** Maximum flexural stress sustained by the test specimen during a bending test (see figure 1, curves a and b).

It is expressed in megapascals (MPa).

3.5 flexural stress at conventional deflection, σ_{fc}**:** Flexural stress at the conventional deflection s_C according to 3.7 (see figure 1, curve c).

It is expressed in megapascals (MPa).

3.6 deflection, s**:** Distance over which the top or bottom surface of the test specimen at midspan has deviated during flexure from its original position.

It is expressed in millimetres (mm).

3.7 conventional deflection, s_C**:** Deflection equal to 1,5 times the thickness h of the test specimen.

It is expressed in millimetres (mm).

Using the span $L = 16h$, the conventional deflection corresponds to a flexural strain of 3,5 % (see 3.8).

3.8 flexural strain, ε_f**:** Nominal fractional change in length of an element of the outer surface of the test specimen at midspan.

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

It is calculated according to the relationship given in 9.2, equation (4).

3.9 flexural strain at break, ε_{fB}**:** Flexural strain at break of the test specimen (see figure 1, curves a and b).

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

3.10 flexural strain at flexural strength, ε_{fM}**:** Flexural strain at maximum flexural stress (see figure 1, curves a and b).

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

3.11 modulus of elasticity in flexure; flexural modulus, E_f**:** Ratio of the stress difference $\sigma_{f2} - \sigma_{f1}$ to the corresponding strain difference values ($\varepsilon_{f2} = 0{,}002\,5$) − ($\varepsilon_{f1} = 0{,}000\,5$) [see 9.2, equation (5)].

It is expressed in megapascals (MPa).

1) To be published. (Revision of ISO 294:1975)

2) To be published. (Revision of ISO 2818:1980)

3) To be published. (Revision of ISO 3167:1983)

NOTES

2 The flexural modulus is only an approximate value of Young's modulus of elasticity.

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

4 Principle

The test specimen, supported as a beam, is deflected at constant rate at the midspan until the specimen fractures or until the deformation reaches some predetermined value. During this procedure the force applied to the specimen is measured.

5 Apparatus

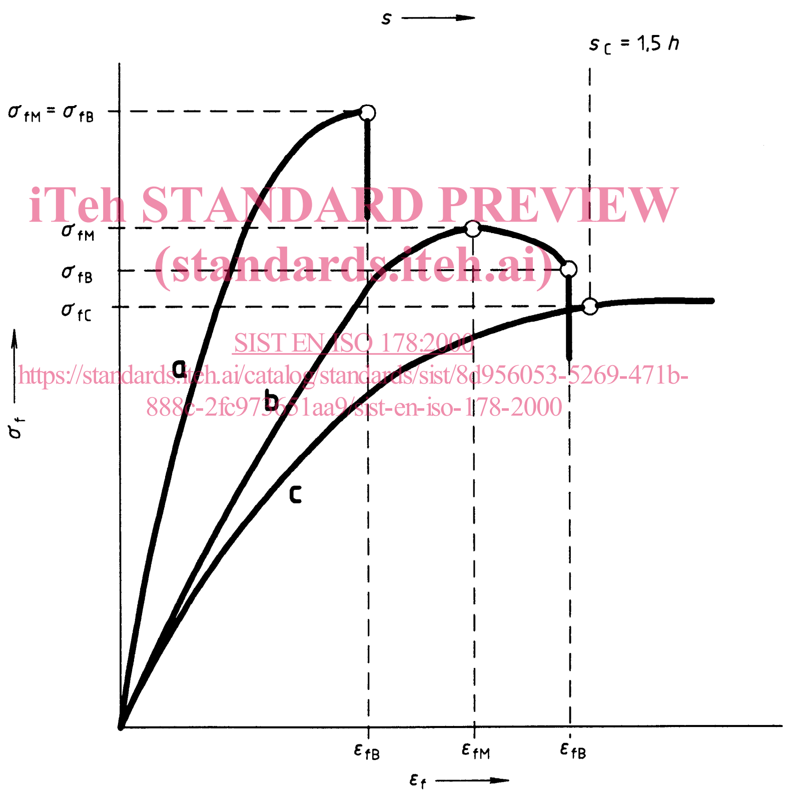
5.1 Testing machine

5.1.1 General

The machine shall comply with ISO 5893 and the requirements given in 5.1.2 to 5.1.4, as follows.

5.1.2 Speed of testing

The testing machine shall be capable of maintaining the speed of testing (see 3.1), as specified in table 1.



Curve a	Specimen that breaks before yielding
Curve b	Specimen that shows a maximum and then breaks before the conventional deflection s_C
Curve c	Specimen that neither has a yield point nor breaks before the conventional deflection s_C

Figure 1 — Typical curves of flexural stress σ_f versus flexural strain ε_f and deflection s