SLOVENSKI STANDARD
SIST EN ISO 179-2:2000

01-maj-2000

Polimerni materiali - Doloļanje udarne ģilavosti po Charpyju - 2. del: Preskus udarne ģilavosti z instrumentalnim prikazom (ISO 179-2:1997)

Plastics - Determination of Charpy impact properties - Part 2: Instrumented impact test (ISO 179-2:1997)

Kunststoffe - Bestimmung der Charpy-Schlageigenschaften - Teil 2: Instrumentierte Schlagzähigkeitsprüfung (ISO 179-2:1997)

Plastiques - Détermination des caractéristiques au choc Charpy - Partie 2: Essai de choc instrumenté (ISO 179-2:1997)

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83.080.01	Polimerni materiali na splošno	Plastics in general

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Plastics - Determination of Charpy impact properties - Part 2: Instrumented impact test (ISO 179-2:1997)

Plastiques - Détermination des caractéristiques au choc Charpy - Partie 2: Essai de choc instrumenté (ISO 179-2:1997)

Kunststoffe - Bestimmung der Charpy-Schlageigenschaften - Teil 2: Instrumentierte Schlagzähigkeitsprüfung (ISO 179-2:1997)

This European Standard was approved by CEN on 6 May 1999.

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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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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 179-2:1999 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 "Plastics", the secretariat of which is held by IBN.

This European Standard replaces EN ISO 179:1996.

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of an identical text or by endorsement, at the latest by December 1999, and conflicting national standards shall be withdrawn at the latest by December 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, 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 179-2:1997 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO 179-2

First edition
1997-12-15

Plastics — Determination of Charpy impact properties —

Part 2:
Instrumented impact test

Plastiques — Détermination des caractéristiques au choc Charpy —

Partie 2: Essai de choc instrumenté

Reference number
ISO 179-2:1997(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 179-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

ISO 179 consists of the following parts, under the general title *Plastics — Determination of Charpy impact properties*:

— *Part 1: Non-instrumented impact test*

— *Part 2: Instrumented impact test*

Annexes A to C of this part of ISO 179 are for information only.

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Plastics — Determination of Charpy impact properties —

Part 2:
Instrumented impact test

1 Scope

1.1 This part of ISO 179 specifies a method for determining Charpy impact properties of plastics from force-deflection diagrams. Different types of rod-shaped test specimen and test configuration, as well as test parameters depending on the type of material, the type of test specimen and the type of notch are defined in part 1 of ISO 179.

Dynamic effects such as load-cell/striker resonance, test specimen resonance and initial-contact/inertia peaks are described (see figure 1, curve b, and annex A).

1.2 For the comparison between Charpy and Izod test methods, see ISO 179-1, clause 1.

ISO 179-1 is suitable for characterizing the impact behaviour by the impact strength only and for using apparatus whose potential energy is matched approximately to the particular energy to break to be measured (see ISO 13802, annex C). This part of ISO 179 is used if a force-deflection or force-time diagram is necessary for detailed characterization of the impact behaviour, and for developing automatic apparatus, i.e. avoiding the need, mentioned above, to match energy.

1.3 For the range of materials which may be tested by this method, see ISO 179-1, clause 1.

1.4 For the general comparability of test results, see ISO 179-1, clause 1.

1.5 The method may not be used as a source of data for design calculations on components. However, the possible use of data is not the subject of this part of ISO 179. Any application of data obtained using this part of ISO 179 should be specified by a referring standard or agreed upon by the interested parties.

Information on the typical behaviour of materials can be obtained by testing at different temperatures, by varying the notch radius and/or specimen thickness and by testing specimens prepared under different conditions.

It is not the purpose of this part of ISO 179 to give an interpretation of the mechanism occurring at every point on the force-deflection diagram. These interpretations are a task for on-going scientific research.

1.6 The test results are comparable only if the conditions of test specimen preparation, as well as the test conditions, are the same. Comprehensive evaluation of the reaction to impact stress requires that determinations be made as a function of deformation rate and temperature for different material variables such as crystallinity and moisture content. The impact behaviour of finished products cannot, therefore, be predicted directly from this test, but test specimens may be taken from finished products for testing by this method.

1.7 Impact strengths determined by this method may replace those determined using ISO 179-1 if comparability has been established by previous tests.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 179. 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 179 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 179-1:—[1], *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test.*

ISO 13802:—[2], *Plastics — Verification of pendulum impact-testing machines — Charpy, Izod and tensile impact testing*.

3 Definitions

For the purposes of this part of ISO 179, the definitions given in part 1 apply, together with the following:

3.1 impact velocity, v_0**:** The velocity of the striker relative to the test specimen supports at the moment of impact.

It is expressed in metres per second (m/s).

3.2 inertial peak: The first peak in a force-time or force-deflection diagram. It arises from the inertia of that part of the test specimen accelerated after the first contact with the striker (see figure 1, curve b, and annex A).

3.3 impact force, F**:** The force exerted by the striking edge on the test specimen in the direction of impact.

It is expressed in newtons (N).

3.4 deflection, s**:** The displacement of the striker relative to the test specimen supports after impact, starting at first contact between striker and test specimen.

It is expressed in millimetres (mm).

3.5 impact energy, W**:** The energy expended in accelerating, deforming and breaking the test specimen during the deflection s.

It is expressed in joules (J).

It is measured by integrating the area under the force-deflection curve from the point of impact to the deflection s.

3.6 maximum impact force, F_M**:** The maximum value of the impact force in a force-time or force-deflection diagram (see figure 1).

It is expressed in newtons (N).

3.7 deflection at maximum impact force, s_M**:** The deflection at which the maximum impact force F_M occurs (see figure 1).

It is expressed in millimetres (mm).

1) To be published. (Revision of ISO 179:1993)
2) To be published.

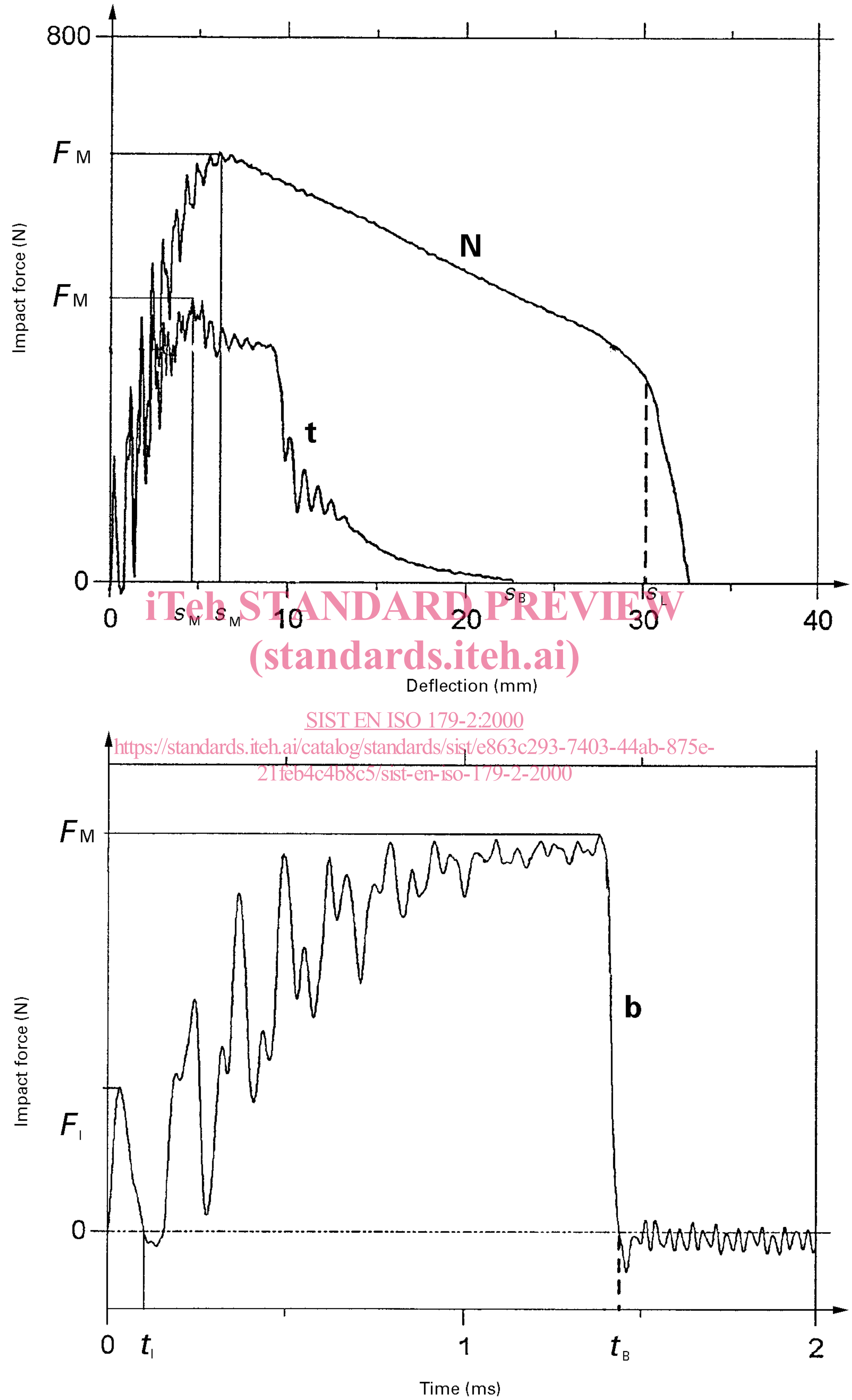
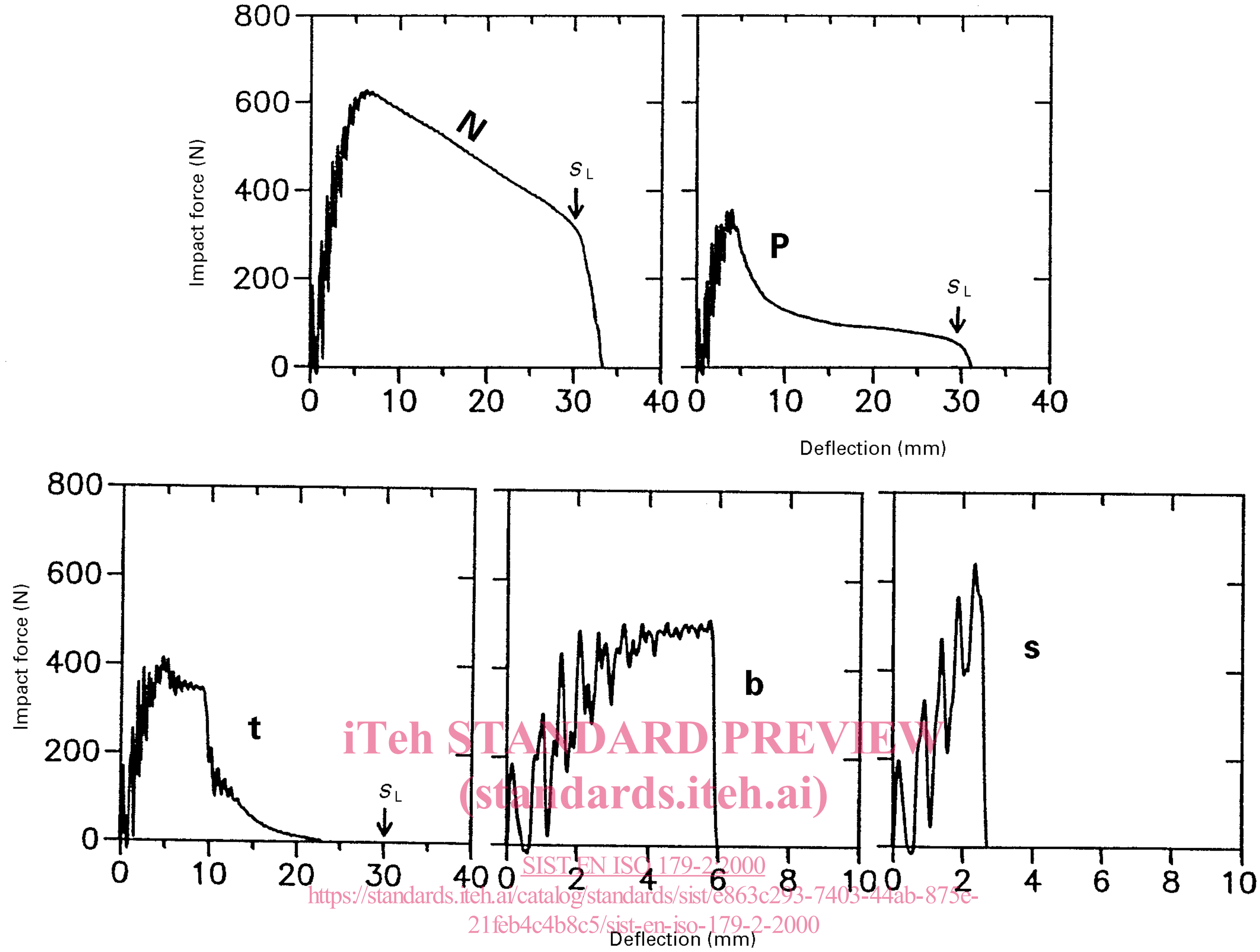


Figure 1 — Typical force-deflection (N and t) and force-time (b) curves
(for the types of failure, see figure 2)



N = no break: yielding followed by plastic deformation up to the deflection limit s_L;

P = partial break: yielding followed by stable cracking, resulting in a force at the deflection limit s_L which is greater than 5 % of the maximum force;

t = tough break: yielding followed by stable cracking, resulting in a force at the deflection limit s_L which is less than or equal to 5 % of the maximum force;

b = brittle break: yielding followed by unstable cracking;

s = splintering break: unstable cracking followed by yielding;

s_L = deflection limit; beginning of pull-through.

NOTE — Due to the different modes of deformation, force-deformation curves obtained using this part of ISO 179 show features which are different from those obtained using ISO 6603-2 [1]. In particular, the first damage event in instrumented puncture tests frequently appears as a slight sudden force decrease (crack initiation), followed by a gradual force increase. Force increases after crack initiation are never observed in instrumented three-point-bending impact tests. Furthermore, inertial effects are not as pronounced in plate impact tests as they are in bending impacts tests (see annex A).

Figure 2 — Typical force-deflection curves showing different failure modes for type 1 specimens tested edgewise

3.8 energy to maximum impact force, W_M**:** The energy expended up to the deflection at maximum impact force.

It is expressed in joules (J).

3.9 deflection at break, s_B**:** The deflection at which the impact force is reduced to less than or equal to 5 % of the maximum impact force F_M (see figure 1).

It is expressed in millimetres (mm).

It is necessary to differentiate between the deflection at break s_B and the deflection limit s_L at the beginning of pull-through (see figure 1, curve N) which is determined by the length l and width b of the test specimen and the distance L between the specimen supports. For type 1 specimens in the edgewise position, s_L is in the range 32 mm to 34 mm.

NOTE — Using type 1 specimens tested edgewise, apparent deflection limits are sometimes observed, i.e. unexpectedly low values (down to only 20 mm) at which the impact force drops to zero, but the specimens do not break. Carrying out the test slowly shows that, in such cases, the specimen changes from the edgewise to the more stable flatwise position by a combined bending-twisting deformation. This can easily be confirmed by checking the specimen after the test: it is bent with respect to an axis not parallel, but inclined to, the specimen width.

This behaviour is caused by the high ratio between the edgewise and the flatwise flexural rigidity of the specimen and is triggered by a small asymmetry feature e.g. the draft angle.

This phenomenon may be avoided by fitting guide elements in front of, but not connected to, the instrumented striking edge, thus preventing the central part of the specimen from twisting to any great extent.

3.10 impact energy at break, W_B**:** The impact energy up to the deflection at break s_B.

It is expressed in joules (J).

3.11 Charpy (notched) impact strength, a_{cU} (a_{cN})**:** The impact energy at break relative to the initial central cross-sectional area A (A_N) of the unnotched (notched) specimen (see 8.4 and ISO 179-1, 3.1 and 3.2).

It is expressed in kilojoules per square metre (kJ/m^2).

3.12 type of failure: The type of deformation behaviour of the material under test (see figure 2). It may be either no break (N), partial break (P), tough (t), brittle (b) or splintering (s).

Types t, b and s represent subgroups of the complete break C and hinge break H defined in part 1 of ISO 179. For these types, values of the impact energy at break W_B, and thus for the Charpy impact strength, may be averaged to give a common mean value. For specimens giving a partial break P and for materials exhibiting interlaminar shear fracture, see ISO 179-1, subclause 7.6. For specimens showing more than one failure type, see ISO 179-1, subclause 7.7.

NOTE — As can be seen from figure 2, the deflection and the impact energy at maximum force are identical to the deflection and impact energy at break in the case of splintering failure (see curve s) and brittle failure (see curve b), where unstable cracking takes place at the maximum impact force.

4 Principle

A rod-shaped test specimen, supported near its ends as a horizontal beam, is impacted perpendicularly, with the line of impact midway between the supports, and bent at a high, nominally constant velocity. The impact geometry is described in ISO 13802, clause 5. During the impact, the impact force is recorded. Depending on the method of evaluation, the deflection of the specimen may be either measured directly by suitable measuring devices or, in the case of energy carriers which give a frictionless impact, calculated from the initial velocity and the force as a function of time. The force-deflection diagram obtained in these tests describes the high-bending-rate impact behaviour of the specimen from which several aspects of the material properties may be inferred.

5 Apparatus

5.1 Test machine

5.1.1 Basic components

The basic components of the test machine are the energy carrier, the striker and the frame with its specimen supports. The energy carrier may be of the inertial type (e.g. a pendulum or free-falling dart, which may be spring or pneumatically assisted before impact) or of the hydraulic type.