SLOVENSKI STANDARD
SIST EN ISO 6603-2:2000

01-maj-2000

Polimerni materiali - Ugotavljanje veļ osne udarne odpornosti togih polimernih materialov - 2. del: Instrumentalna metoda (ISO 6603-2:1989)

Plastics - Determination of multiaxial impact behaviour of rigid plastics - Part 2: Instrumented puncture test (ISO 6603-2:1989)

Kunststoffe - Bestimmung des mehrachsigen Stoßverhaltens von festen Kunststoffen - Teil 2: Instrumentierter Durchstoßversuch (ISO 6603-2:1989)

Plastiques - Détermination du comportement des plastiques rigides sous un choc multiaxial - Partie 2: Essai par perforation instrumentée (ISO 6603-2:1989)

Ta slovenski standard je istoveten z: **EN ISO 6603-2:1996**

ICS:

83.080.01	Polimerni materiali na splošno	Plastics in general

SIST EN ISO 6603-2:2000 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 6603-2

December 1996

ICS 83.080

Descriptors: see ISO document

English version

Plastics - Determination of multiaxial impact behaviour of rigid plastics - Part 2: Instrumented puncture test (ISO 6603-2:1989)

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REPUBLIKA SLOVENIJA
MINISTRSTVO ZA ZNANOST IN TEHNOLOGIJO
Urad RS za standardizacijo in meroslovje
LJUBLJANA

SIST EN ISO 6603-2

PREVZET PO METODI RAZGLASITVE -05- 2000

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.

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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 6603-2:1996 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 "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of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.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 6603-2:1989 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO 6603-2

First edition
1989-12-15

Plastics — Determination of multiaxial impact behaviour of rigid plastics —

Part 2 : Instrumented puncture test

Plastiques — Détermination du comportement des plastiques rigides sous un choc multiaxial —

Partie 2 : Essai par perforation instrumentée

Reference number
ISO 6603-2:1989(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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6603-2 was prepared by Technical Committee ISO/TC 61, *Plastics*.

ISO 6603 consists of the following parts, under the general title *Plastics — Determination of multiaxial impact behaviour of rigid plastics*:

— *Part 1: Falling dart method*

— *Part 2: Instrumented puncture test*

Annexes A and B and C and D of this part of ISO 6603 are for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Plastics — Determination of multiaxial impact behaviour of rigid plastics —

Part 2 :
Instrumented puncture test

1 Scope

1.1 This part of ISO 6603 specifies a method for the determination of the multiaxial impact behaviour of rigid plastics in the form of flat test specimens, such as discs and squares, moulded directly or cut from sheets.

This test is used for the characterization of plastic sheeting or mouldings under the impact of a striker applied at a right angle to the plane of the sheet.

Different test parameters are specified depending on the geometry of the striker.

1.2 ISO 6603-1[1] can be used if it is sufficient to characterize the impact behaviour of plastics by an impact-failure energy. This part of ISO 6603 is for use if a force-deformation or force-time diagram recorded at practically constant striker velocity is necessary for characterization of the impact behaviour.

This applies if:

— measured quantities derivable only from this diagram are required;

— only a small number of test specimens is available.

1.3 The test method is applicable to test specimens with a thickness between 1 mm and 4 mm.

NOTE 1 For thicknesses less than 1 mm, ISO 7765-2 should be used. Thicknesses greater than 4 mm may be tested if the equipment is suitable, but the test then falls outside the scope of this part of ISO 6603.

1.4 The test results are comparable only if the conditions of the preparation of the specimens, their dimensions and surfaces as well as the testing conditions are the same. In particular, results determined on test specimens of different thicknesses cannot be compared with one another. Comprehensive evaluation of the reaction to impact stress requires that determinations be made as a function of deformation rate and temperature for different materials variables, such as crystallinity and moisture content. The impact behaviour of finished products cannot be predicted directly from this test, but specimens may be taken from finished products for tests by this method.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6603. 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 6603 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.*

1) ISO 6603-1:1985, *Plastics — Determination of multiaxial impact behaviour of rigid plastics — Part 1: Falling dart method.*

ISO 294:1975, *Plastics — Injection moulding test specimens of thermoplastic materials.*

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

ISO 7765-2:—[2], *Plastics — Film and sheeting — Determination of impact resistance by the free-falling-dart method — Part 2: Instrumented puncture test.*

3 Definitions

For the purposes of this part of ISO 6603, the following definitions apply.

3.1 peak force, F_p: The maximum force exerted by the striker in the direction of impact during the test (see figures 1, 2 and 3).

3.2 deformation at peak force, l_p: The deformation at the centre of the test specimen corresponding to the peak force. For materials exhibiting a peak force plateau, the deformation is taken at the centre of the plateau (see figures 1 and 2).

3.3 energy to peak force, E_p: The area under the force-deformation diagram bounded by the origin, the peak force and the deformation at peak force (see figures 1, 2 and 3).

3.4 total penetration energy, E_{tot}: The total energy expended in penetrating the test specimen (see figures 1, 2 and 3).

4 Principle

The test specimen is penetrated normal to the plane by a striker at a nominally uniform velocity. The resulting force-deformation or force-time diagram is electronically recorded. The test specimen may or may not be clamped in position during the test.

The force-deformation diagram obtained in these tests records the behaviour under impact of the specimen from which several features of the behaviour of the material may be inferred.

For example, the fracture may be "brittle", "ductile", "tough" or characterized by initial damage or by crack initiation and propagation. In addition, dynamic effects may be present such as load cell/indentor resonance, specimen resonance and initial contact/inertia peaks (see annex A).

In all cases, care must be exercised in analysing these features because the operative mechanism and the trains of inference are not yet fully established and are the subject of continuing research.

NOTES

2 Examples of force-deformation diagrams for tough and brittle materials are given in figures 1 to 3, with more complex behaviour being described in annex A.

3 It is not the purpose of this part of ISO 6603 to give an interpretation of the mechanism occurring on every particular point of the force-deformation diagram. These interpretations are a task for scientific research.

5 Apparatus

The apparatus consists of a mechanical part for applying the test force (test device), the instruments for measuring the force and distance, and a thickness gauge.

5.1 Test device

The essential components of the test device are: the energy carrier (normally a falling mass, but a pneumatically or hydraulically or spring-assisted driven mass or a pendulum-impact test device may also be used), the striker, and the test specimen support (with a clamping ring, where used).

The test device shall permit the test specimen to be punctured at the centre at a nominally constant velocity perpendicular to the specimen surface. The force exerted on the test specimen in the direction of impact and the deformation of the specimen in the direction of impact shall be derivable or measurable (see figure 4). Devices suitable for this test are falling-dart machines, pendulums with an arm long enough for the penetration path to be regarded as approximately linear, and high-speed tensile-testing machines with suitable auxiliary attachments.

5.1.1 Energy carrier

It shall be ensured that the available impact energy (e.g. drop energy) is large in comparison with the absorbed penetration energy, E_{tot}. Because, over the range of velocities used in this test, the striker velocity has a relatively small influence on the viscoelastic behaviour of plastics, a decrease in striker velocity of 20 % is acceptable. This requirement is met by falling-dart machines and pendulums if

$$m \geqslant \frac{3E_{tot}}{g \cdot h_o}$$

where

m is the falling mass, in kilograms;

g is the acceleration due to gravity (9,81 m/s²);

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2) To be published.

h_o is the height of fall, in metres;

E_{tot} is the total penetration energy, in joules.

If a falling-dart system is used, it shall be capable of holding and releasing a weighted striker such that the striker falls constrained by guide(s). The fall shall be largely without friction or losses through windage. Any friction shall be considered in the calculations.

NOTE 4 In many cases, a weighted striker with a total mass of 20 kg has been found to be sufficient for the larger striker and of 5 kg for the smaller striker (see 5.1.2).

Velocity-measuring sensors shall be placed close to the point of impact to compensate for the effects of friction.

With hydraulically driven high-speed tensile-testing machines, any deviation of the velocity during impact shall be proven, e.g. by recording the distance-time curve and checking its slope.

5.1.2 Striker

The preferred striker has a polished hardened hemispherical striking surface of diameter 20 mm ± 0,2 mm. Alternatively, a 10 mm ± 0,1 mm diameter striking surface may be used. The striker shall be constructed of steel.

The load cell on the striker shall be mounted as close as possible to the tip to minimize all extraneous forces. An example is shown in figure 4.

The resonant frequency of the combination of striker and load cell shall be higher than that specified in 5.2.

5.1.3 Test specimen support

A hollow steel cylinder of internal diameter 40 mm ± 2 mm and minimum height 12 mm shall be used. The support shall be placed on a solid base and shall be designed such that air cannot be trapped under the test specimen, thus avoiding a possible spring effect. Below the support, enough space shall be available as stopping distance for the striker after total penetration of the test specimen.

5.1.4 Clamping device (optional)

A two-piece annular specimen clamp having an inside diameter of 40 mm ± 2 mm is recommended (see figure 5). Pneumatically operated clamps have been successfully employed. If a clamping device is used, ensure that no slippage occurs.

NOTE 5 The results for clamped and unclamped specimens are likely to be different.

5.2 Instruments for measuring force and distance

The electronic devices for measuring force and distance shall be chosen such that the force and distance can be measured to within 5 %.

EXAMPLE — If the resolution of an electronic device is 0,4 % of full-scale deflection (FSD) and the measured value in a test is 20 % of FSD, then the resolution for the test is 2 %.

Because of the very short time to failure (t_f) of the test specimen during the test, only electronic load cells with a high natural frequency shall be used.

The shortest failure time $t_{f,min}$ measurable by the apparatus shall be as given by

$$t_{f,min} \geqslant \frac{5}{f_{dev}}$$

where f_{dev} is the natural frequency of the test device (striker plus load cell).

For the bandwidth b_{tot} of the amplifier train (direct current or carrier frequency amplifier) with a lower bandwidth limit of 0 Hz, the following applies by analogy:

$$b_{tot} \geqslant \frac{16}{t_{f,min}}$$

where

$$b_{tot} = \left(\sum_{j=1}^{n} \frac{1}{b_j^2} \right)^{-\frac{1}{2}}$$

b_j being the bandwidth of the jth component amplifier.

The deformation of the specimen in the direction of penetration can be determined directly with an electronic transducer, thus yielding a force-deformation diagram. It is also possible to use a force-time diagram and calculate the deformation in accordance with clause 8.

NOTES

6 An example of such a measurement train is a piezo-load cell mounted between the striker and the shaft (see figure 4) and connected to a charge amplifier.

7 In the testing of very brittle products, elastic impact may cause resonant oscillations in the load cell and make it difficult to interpret the force-deformation curve. In this case it can be useful to insert a low-pass filter between the force signal amplifier and the recorder, although the accuracy of the measurements is thereby reduced.

If a filter is used, the type of filter and its essential characteristics shall be reported in the test report [see clause 9 e)].