INTERNATIONAL STANDARD

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Second edition
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Plastics — Determination of tensile-impact strength

Plastiques — Détermination de la résistance au choc-traction

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 8256 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

This second edition cancels and replaces the first edition (ISO 8256:1990), which has been technically revised.

Plastics — Determination of tensile-impact strength

1 Scope

1.1 This International Standard specifies two methods (method A and method B) for the determination of the tensile-impact strength of plastics under defined conditions. The tests can be described as tensile tests at relatively high strain rates. These methods can be used for rigid materials (as defined in ISO 472), but are especially useful for materials too flexible or too thin to be tested with impact tests conforming to ISO 179 or ISO 180.

1.2 These methods are used for investigating the behaviour of specified specimens under specified impact velocities, and for estimating the brittleness or the toughness of specimens within the limitations inherent in the test conditions.

1.3 These methods are applicable both to specimens prepared from moulding materials and to specimens taken from finished or semi-finished products (for example mouldings, laminates, or extruded or cast sheets).

1.4 Results obtained by testing moulded specimens of different dimensions may not necessarily be the same. Equally, specimens cut from moulded products may not give the same results as specimens of the same dimensions moulded directly from the material. Test results obtained from specimens prepared from moulding compounds cannot be applied directly to mouldings of any given shape, because values may depend on the design of the moulding and the moulding conditions. Results obtained by method A and method B may or may not be comparable.

1.5 These methods are not suitable for use as a source of data for design calculations on components. Information on the typical behaviour of a material can be obtained, however, by testing different types of test specimen prepared under different conditions, and by testing at different temperatures. The two different methods are suitable for production control as well as for quality control.

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 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 179-2, *Plastics — Determination of Charpy impact properties — Part 2: Instrumented impact test*

ISO 180, *Plastics — Determination of Izod impact strength*

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

ISO 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-2, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 2: Small tensile bars*

ISO 294-3, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

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

ISO 472, *Plastics — Vocabulary*

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

ISO 2602, *Statistical interpretation of tests results — Estimation of the mean — Confidence interval*

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

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 10350-1, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 11403-3, *Plastics — Acquisiton and presentation of comparable multipoint data — Part 3: Environmental influences on properties*

ISO 13802, *Plastics — Verification of pendulum impact-testing machines — Charpy, Izod and tensile impact-testing*

3 Terms and definitions

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

3.1
tensile-impact strength of unnotched specimens

a_{tU}

energy absorbed in breaking an unnotched specimen under specified conditions, referred to the original cross-sectional area of the specimen

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

3.2
tensile-impact strength of notched specimens

a_{tN}

energy absorbed in breaking a notched specimen under specified conditions, referred to the original cross-sectional area of the specimen at the notch

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

4 Principle

A specimen is broken by a single impact at the bottom of the swing of the pendulum of a tensile-impact machine. The specimen is horizontal at the moment of rupture. One end of the specimen, at impact, is held either by the frame or the pendulum and the other end by the crosshead. The two methods described are based on two different ways of positioning the specimen held by the crosshead: the specimen may be either mounted stationary on the support frame (method A) or carried downward together with the pendulum (method B).

The energy to fracture is determined by the kinetic energy extracted from the pendulum in the process of breaking the specimen. Corrections are made for the energy to toss (method A) or bounce (method B) the crosshead.

5 Apparatus

5.1 Test machine

The principles, characteristics and verification of suitable test machines are detailed in ISO 13802.

5.2 Pendulum and striker

5.2.1 The pendulum shall be constructed of a single- or multiple-membered arm holding the head, in which the greatest mass is concentrated. A rigid pendulum is essential to maintain the proper clearances and geometric relationships between related parts and to minimize energy losses, which are always included in the measured impact-energy value.

5.2.2 The strikers for method A and method B are described in detail in ISO 13802.

5.3 Crosshead

5.3.1 As pointed out in ISO 13802, in order to reduce bouncing due to the impact of the metal striker on the metal crosshead, the material used for the crosshead shall be one which gives an essentially inelastic impact (e.g. aluminium). The mass of the crosshead, both for method A and for method B, shall be selected from the values given in Table 1.

5.3.2 A jig or other device shall be used to assist in clamping the crosshead in the specified position, at right angles to the longitudinal axis of the specimen.

Table 1 — Crosshead masses

Potential energy J	Crosshead mass g	
	Method A	Method B
2,0	15 ± 1 or 30 ± 1	15 ± 1
4,0	15 ± 1 or 30 ± 1	15 ± 1
7,5	30 ± 1 or 60 ± 1	30 ± 1
15,0	30 ± 1 or 60 ± 1	120 ± 1
25,0	60 ± 1 or 120 ± 1	120 ± 1
50,0	60 ± 1 or 120 ± 1	120 ± 1
NOTE For method A, use the lighter crosshead whenever possible.		

5.4 Clamping devices/jaws

Clamps and jaws for tensile-impact testing are described in ISO 13802.

5.5 Micrometers and gauges

Micrometers and gauges suitable for measuring the dimensions of test specimens to an accuracy of 0,01 mm are required. In measuring the thickness of the specimen, the measuring face shall apply a load of 0,01 MPa to 0,05 MPa. For notched specimens, see the requirements of 7.4.

6 Test specimens

6.1 Shape and dimensions

Five types of test specimen, as specified in Table 2 and shown in Figure 1, may be used. In general, all types can be used with either of the two methods.

Method A: To be in agreement with ISO 10350-1 and ISO 11403-3, the preferred specimen types are type 1 (which can be taken from the multipurpose test specimen specified in ISO 3167 or moulded directly in accordance with ISO 294-1) and type 4 (which can be moulded directly in accordance with ISO 294-2 or machined from plates moulded in accordance with ISO 294-3).

Method B: The preferred specimen types are type 2 and type 4.

The test result depends on the type of specimen used and its preparation and thickness. For reproducible results, or in cases of dispute, the type of test specimen and its preparation and thickness shall be agreed upon.

Specimens are tested at their original thickness up to and including 4 mm. The preferred specimen thickness is 4 mm ± 0,2 mm for type 1 specimens and 3 mm ± 0,2 mm for type 4 specimens. Within the gauge area, the thickness shall be maintained to within a tolerance of ± 5 %. Above 4 mm, the test methods described in this International Standard are inapplicable, and ISO 179 or ISO 180 have to be used to determine the impact properties of specimens.

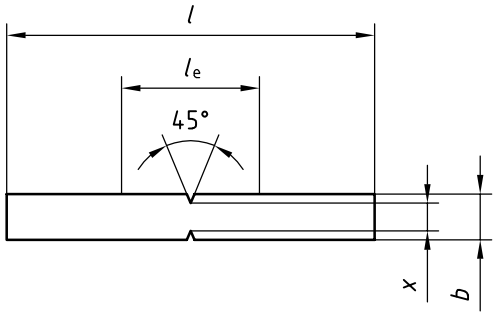
Table 2 — Specimen types and dimensions

Dimensions in millimetres

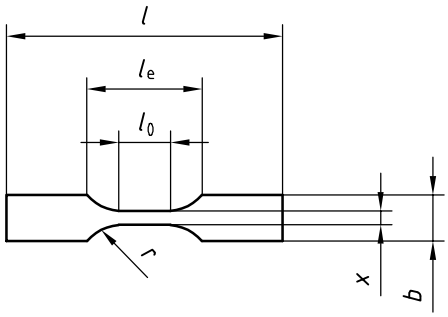
Specimen type	Length l	Width b	Preferred value of dimension x	Preferred value of dimension l_0	Free length between grips l_e	Radius of curvature r
1	80 ± 2	10 ± 0,2	6 ± 0,2	—	30 ± 2	—
2	60 ± 2	10 ± 0,2	3 ± 0,2	10 ± 0,2	25 ± 2	10 ± 1
3	80 ± 2	15 ± 0,2	10 ± 0,2	10 ± 0,2	30 ± 2	20 ± 1
4	60 ± 2	10 ± 0,2	3 ± 0,2	—	25 ± 2	15 ± 1
5[a]	80 ± 2	15 ± 0,2	5 ± 0,2	10 ± 0,2	50 ± 2	20 ± 1

[a] For type 5: b' = 23 mm ± 2 mm, r' = 4 mm ± 0,5 mm, l' = 11 mm ± 1 mm.

Type 1



Type 2



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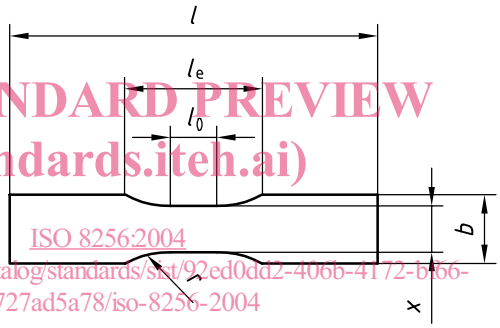
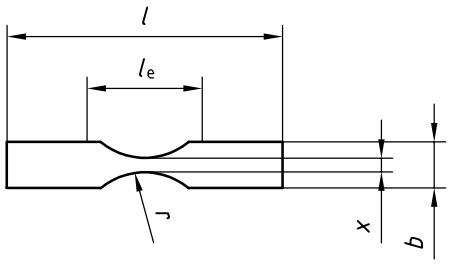


Type 4



Type 5

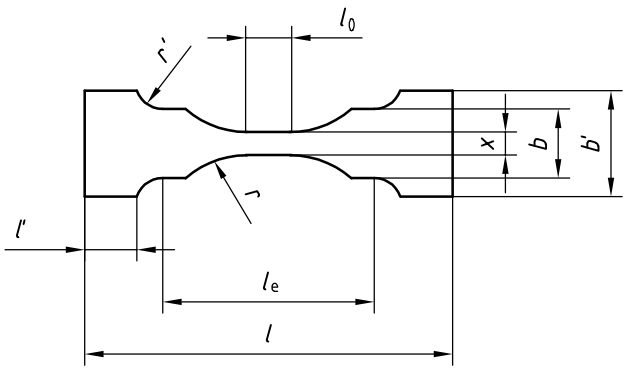


Figure 1 — Types of test specimen

6.2 Preparation

6.2.1 Moulding and extrusion compounds

Specimens shall be prepared in accordance with the relevant material specification. When none exists, or when otherwise specified, specimens shall be directly extruded (in accordance with the standard appropriate to the material), or compression or injection moulded from the material in accordance with ISO 293, ISO 294-1, ISO 294-2 or ISO 295, or machined in accordance with ISO 2818 from sheets or plates compression or injection moulded from the compound. Type 1 specimens can be prepared from the type A multi-purpose test specimen described in ISO 3167.

6.2.2 Sheets

Specimens shall be machined from sheets in accordance with ISO 2818.

6.2.3 Fibre-reinforced resins

A panel shall be prepared from the compound in accordance with the relevant part of ISO 1268, and specimens shall be machined in accordance with ISO 2818.

6.3 Notching of specimens

6.3.1 Notches (for type 1 specimens) shall be machined in accordance with ISO 2818 on unnotched specimens prepared in accordance with 6.2.

6.3.2 The radius of the notch base shall be 1,0 mm ± 0,05 mm and its angle 45° ± 1° (see Figure 1). The profile of the cutting tooth shall be such as to produce in the specimen, at right angles to its principal axis, two notches of the contour and depth shown in Figure 1. The two lines drawn perpendicular to the length direction of the specimen through the apex of each notch shall be within 0,2 mm of each other. Particular attention shall be given to the accuracy of the dimension x (see Table 2). Close tolerances have to be imposed on the contour and the radius of the notch for most materials because these factors largely determine the degree of stress concentration at the base of the notch during the test. The maintenance of a sharp, clean-edged cutting tool is particularly important since minor defects at the base of the notch can cause large deviations in the test results. The profile of the notch being produced by a particular cutting tool shall be checked at regular intervals.

6.3.3 Specimens with moulded-in notches may be used if specified for the material being tested. Specimens with moulded-in notches generally do not give the same results as specimens with machined notches, and allowance should be made for this difference in interpreting the results. Specimens with machined notches are generally preferred because skin effects and/or localized anisotropy are minimized. The profile of the notch being produced shall be checked at regular intervals.

6.3.4 For specimens prepared by cutting them out with a puncher, the notch shall not be punched out but shall be machined in a second step.

6.4 Number of test specimens

Unless otherwise specified in the standard for the material being tested, a set consisting of ten specimens shall be tested. When the coefficient of variation (see ISO 2602) has a value of less than 5 %, a minimum number of five test specimens is sufficient.

6.5 Anisotropy

The impact properties of certain types of sheet material may differ depending on the direction of measurement in the plane of the sheet. In such cases, it is customary to prepare two groups of test specimens with their major axes respectively parallel and perpendicular to the direction of some feature of the sheet which is either visible or can be inferred from knowledge of the method of manufacture of the sheet.

6.6 Conditioning

Unless otherwise specified in the standard for the material being tested, the specimens shall be conditioned in accordance with ISO 291, unless other conditions are agreed upon by the interested parties. In the case of notched specimens, the conditioning time starts after notching.

7 Procedure

7.1 Conduct the test in the same atmosphere as that used for conditioning, unless other conditions are agreed upon by the interested parties (e.g. for testing at high or low temperature).

7.2 Check that the impact machine is able to perform the test with the specified velocity of impact and that the energy absorbed is in the correct range, i.e. between 20 % and 80 % of the energy available at impact. If more than one of the pendulums conform to these requirements, the pendulum having the highest energy shall be used.

7.3 Determine the frictional losses in accordance with ISO 13802.

7.4 Measure the thickness h and the width x of the central, parallel-sided section of the test specimen to the nearest 0,02 mm. In the case of notched specimens, carefully measure the dimension x using a micrometer fitted with an anvil of width 2 mm to 3 mm and of suitable profile to fit the shape of the notch.

In the case of injection-moulded specimens, it is not necessary to measure the dimensions of each specimen. It is sufficient to measure one specimen from a set to make sure that the dimensions correspond to those requested. With multiple-cavity moulds, ensure that the dimensions of the specimens are the same for each cavity.

7.5 Lift the pendulum to the prescribed height and arrest it. Insert the specimen in the holder and tighten firmly: for method A, place one end of the specimen inside the vice jaw of the frame and the other inside the crosshead clamp; for method B, place one end of the specimen inside the secured specimen clamp and the other inside the unsecured crosshead/specimen clamp (see ISO 13802 for details).

7.6 Release the pendulum. Record the impact energy E_s absorbed by the specimen and apply corrections for frictional losses if necessary in accordance with ISO 13802.

7.7 If the resulting corrected tensile-impact energy is below 20 % of the capacity of the 2,0 J pendulum, the data should be considered suspect.

In cases where the specimen is weak, rigid multi-layered specimens may be used. Use of such specimens shall be by agreement between the interested parties and shall be clearly documented in the test report.

7.8 If various materials are to be compared, pendulums with the same velocity at impact shall be used for each. In cases of dispute, it is recommended that test results be compared only with results obtained with pendulums of identical nominal energy and specimens of the same geometry.

7.9 Immediately after the test has been completed, a check shall be made to ensure that the specimen was firmly clamped or whether it had slipped in one of the two grips, and that the failure occurred in the narrow, parallel-sided part of the specimen. If any of the specimens tested do not meet these requirements, the results for these specimens shall be discarded and additional specimens tested.