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Plastics — Determination of Charpy impact properties —

Part 1: Non-instrumented impact test

Plastiques — Détermination des caractéristiques au choc Charpy — Partie 1: Essai de choc non instrumenté

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical behavior,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 179-1:2010), which has been technically revised.

The main changes are as follows:

— results of a round robin for unnotched specimens (see Annex B) have been added;

— reference to standard ISO 16012 (see the Bibliography and subclause 5.2) has been added;

— improvements of the micrometers and gauges subclause (see 5.2) have been addressed;

— symbols used in Formulae (1) and (2) have been reviewed and updated.

A list of all parts in the ISO 179 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The Charpy impact properties determination method described in the ISO 179 series has a greater range of applicability than that given in ISO 180 and is more suitable for the testing of materials showing interlaminar shear fracture or of materials exhibiting surface effects due to environmental factors.

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

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

— rigid thermosetting moulding materials (including filled and reinforced compounds) and rigid thermosetting sheets (including laminates);

— fibre-reinforced thermosetting and thermoplastic composites incorporating unidirectional or multi-directional reinforcements (such as mats, woven fabrics, woven rovings, chopped strands, combination and hybrid reinforcements, rovings and milled fibres) or incorporating sheets made from pre-impregnated materials (prepregs), including filled and reinforced compounds;

— thermotropic liquid-crystal polymers.

Notched samples are not normally suitable for use with rigid cellular materials, long-fibre-reinforced composites or thermotropic liquid-crystal polymers. In these cases, unnotched samples may be used.

The method is suited to the use of specimens moulded to the chosen dimensions, machined from the central portion of a standard multipurpose test specimen (see ISO 20753) or machined from finished or semifinished products such as mouldings, laminates and extruded or cast sheet.

Plastics — Determination of Charpy impact properties —

Part 1:
Non-instrumented impact test

1 Scope

This document specifies a method for determining the Charpy impact strength of plastics under defined conditions. A number of different types of specimen and test configurations are defined. Different test parameters are specified according to the type of material, the type of test specimen and the type of notch.

The method can be used to investigate the behaviour of specified types of specimen under the impact conditions defined and for estimating the brittleness or toughness of specimens within the limitations inherent in the test conditions. It can also be used for the determination of comparative data from similar types of material.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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 294-3, *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 1268-11, *Fibre-reinforced plastics — Methods of producing test plates — Part 11: Injection moulding of BMC and other long-fibre moulding compounds — Small plates*

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

ISO 10724-1, *Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs) — Part 1: General principles and moulding of multipurpose test specimens*

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.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
Charpy impact strength of unnotched specimens
a_{cU}
impact energy absorbed in breaking an unnotched specimen, referred to the original cross-sectional area of the specimen

Note 1 to entry: It is expressed in kilojoules per square metre (kJ/m^2).

3.2
Charpy impact strength of notched specimens
a_{cN}
impact energy absorbed in breaking a notched specimen, referred to the original cross-sectional area of the specimen at the notch, where N = A, B or C, depending on the notch type

Note 1 to entry: See 6.3.1.1.2.

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

3.3
edgewise impact
e
direction of blow parallel to the dimension *b*, with impact on the narrow longitudinal surface *h* × *l* of the specimen

Note 1 to entry: See Figure 1 a) and Figures 2 and 4.

3.4
flatwise impact
f
direction of blow parallel to the dimension *h*, with impact on the broad longitudinal surface *b* × *l* of the specimen

Note 1 to entry: See Figure 1 b) and Figures 3 and 4.

3.5
normal direction of blow
n
<laminar-reinforced plastics> impact with the direction of blow normal to the plane of reinforcement

Note 1 to entry: See Figure 4.

3.6
parallel direction of blow
p
<laminar-reinforced plastics> impact with the direction of blow parallel to the plane of reinforcement

Note 1 to entry: See Figure 4.

4 Principle

The test specimen, supported near its ends as a horizontal beam, is impacted by a single blow of a striker, with the line of impact midway between the supports, and bent at a high, nominally constant, velocity.

In the case of edgewise impact with notched specimens, the line of impact is directly opposite the single notch [see Figure 1 a) and Figure 2].

The method specifies preferred dimensions for the test specimen. Tests which are carried out on specimens of different dimensions or with different notches, or specimens which are prepared under different conditions, can produce results which are not comparable. Other factors, such as the energy capacity of the apparatus, the impact velocity and the conditioning of the specimens can also influence

the results. Consequently, when comparative data are required, these factors shall be carefully controlled and recorded.

The method is not intended to be used as a source of data for design calculations. Information on the typical behaviour of a material can be obtained, however, by testing at different temperatures, by varying the notch radius and/or the specimen thickness and by testing specimens prepared under different conditions.

5 Apparatus

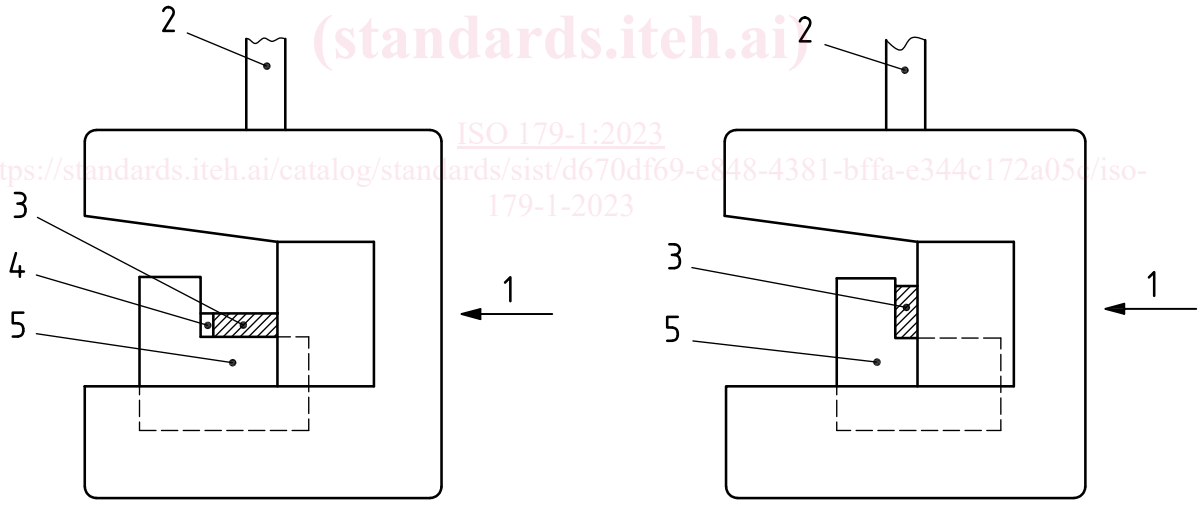
5.1 Test machine

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

ISO 13802 describes partial verification and full verification. In the case of full verification, some items are difficult to verify when the apparatus is assembled. Such verifications are assumed to be incumbent on the manufacturer.

5.2 Micrometers and gauges

Micrometers and gauges shall allow to determine the relevant dimensions of the test specimens with an uncertainty not larger than 0,02 mm. For the determination of the dimension b_N of notched test specimens measuring tips appropriate for the contour of the notch shall be used. For general information on the determination of test specimen dimensions, see ISO 16012.



a) Edgewise impact **b) Flatwise impact**

Key

1 direction of blow
2 rod of pendulum
3 test specimen
4 notch
5 support

Figure 1 — Striking edge and support blocks for type 1 test specimen at moment of impact

6 Test specimens

6.1 Preparation

6.1.1 Moulding and extrusion compounds

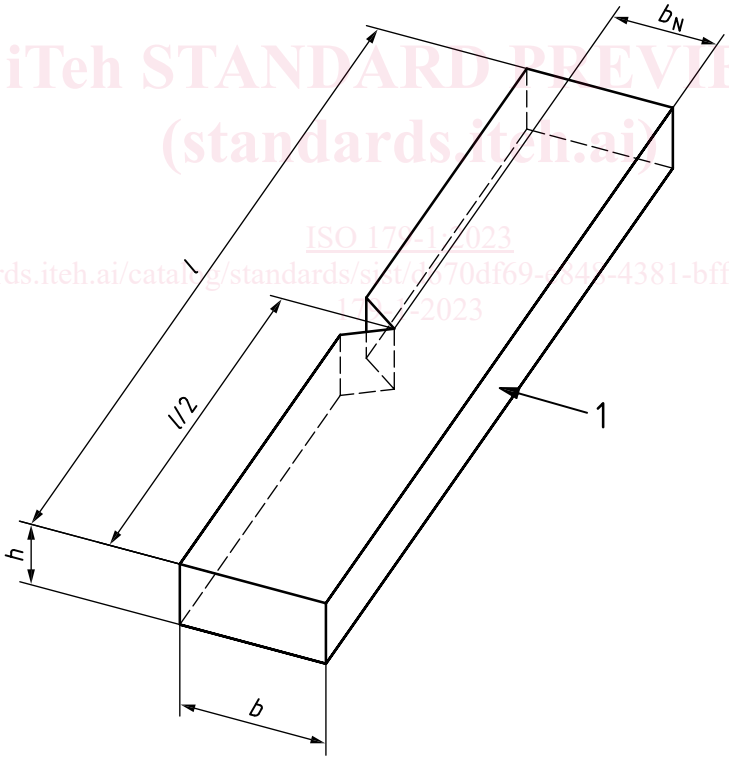
Specimens shall be prepared in accordance with the relevant material specification. The specimens shall be either directly compression moulded in accordance with ISO 293 or ISO 295 or injection moulded from the material in accordance with ISO 294-1, ISO 294-3 or ISO 10724-1, as appropriate, or machined in accordance with ISO 2818 from sheet that has been compression or injection moulded from the compound. Type 1 specimens may be cut from multipurpose test specimens complying with ISO 20753:—, type A1.

6.1.2 Sheets

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

6.1.3 Long-fibre-reinforced materials

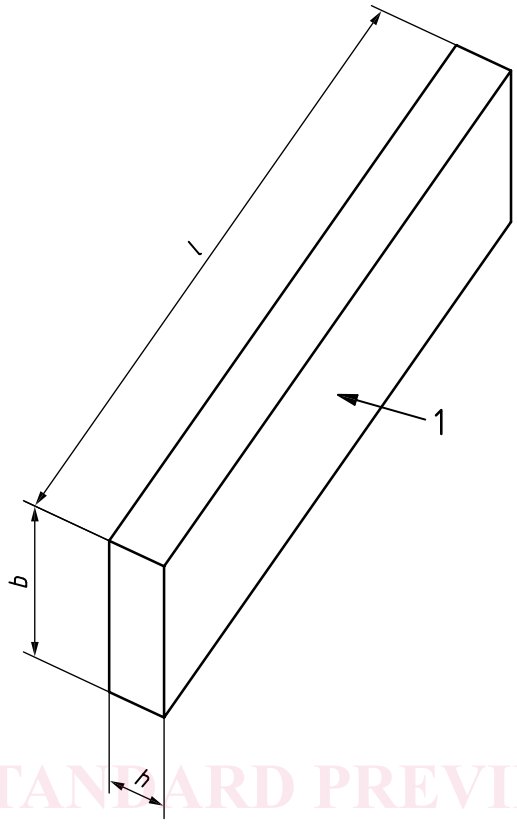
A panel shall be prepared in accordance with ISO 1268-11 or another specified or agreed upon preparation procedure. Specimens shall be machined in accordance with ISO 2818.



Key

1 direction of blow

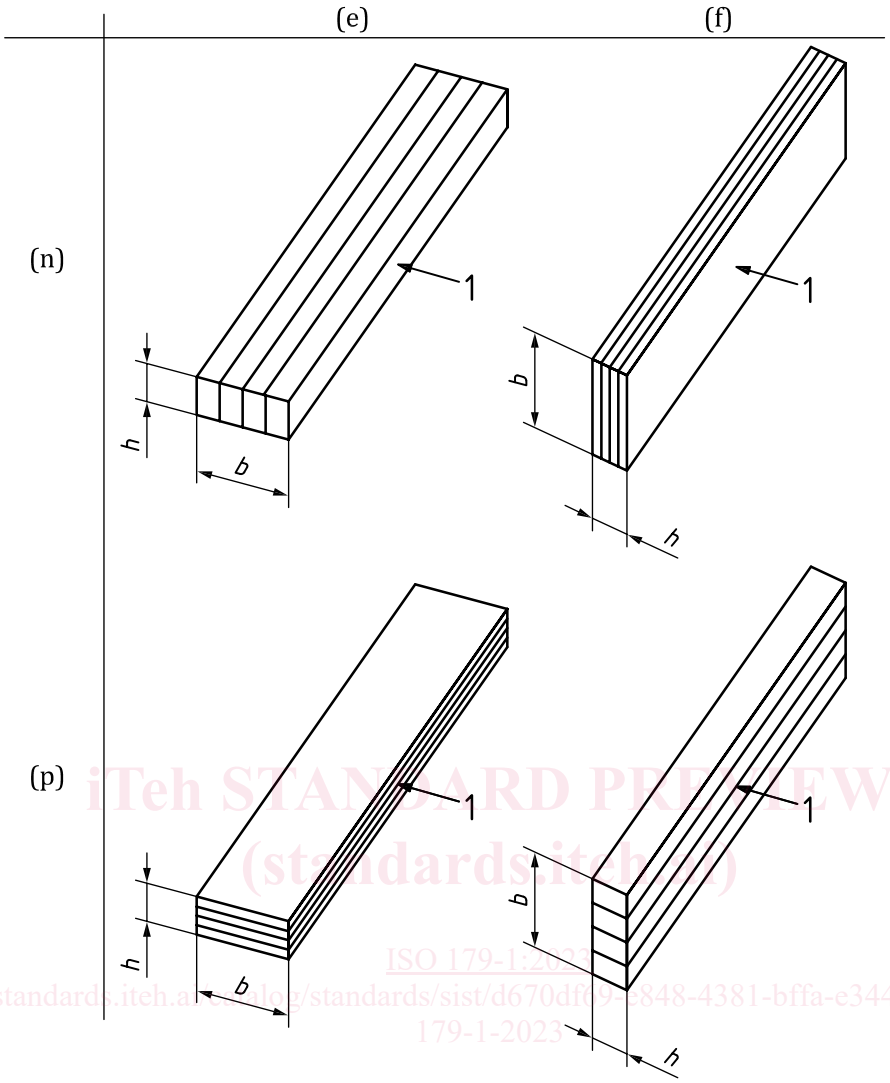
Figure 2 — Charpy edgewise impact (e) with single-notched specimen



Key

1 direction of blow

Figure 3 — Charpy flatwise impact (f)



Key

1 direction of blow
e edgewise
f flatwise
n normal
p parallel

NOTE 1 Edgewise (e) and flatwise (f) indicate the direction of the blow with respect to the specimen thickness, *h*, and specimen width, *b*. Normal (n) and parallel (p) indicate the direction of the blow with respect to the laminate plane.

NOTE 2 The Charpy "fn" and "ep" tests are used for laminates, while both the Charpy "en" and "ep" tests are used for other materials. The Charpy "fn" and "fp" tests are used for testing materials exhibiting surface effects.

Figure 4 — Scheme of designations describing the direction of blow

6.1.4 Checking

The specimens shall be free of twist and shall have mutually perpendicular parallel surfaces. The surfaces and edges shall be free from scratches, pits, sink marks and flash.

The specimens shall be checked for conformity with these requirements by visual observation against straightedges, set squares and flat plates, and by measuring with micrometer callipers.