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Plastics — Compression-moulded sheets of polyethylene (PE-UHMW, PE-HD) — Requirements and test methods

Plastiques — Plaques moulées par compression en polyéthylène (PE-UHMW, PE-HD) — Exigences et méthodes d'essai

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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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products,* 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 fourth edition cancels and replaces the third edition (ISO 15527:2018), which has been technically revised. The main changes compared to the previous edition are as follows:

— The minimum value of double-notched impact strength for PE-UHMW group 1.1 in Table 2 has been changed from >40 kJ/m^2 to >80 kJ/m^2.

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.

Plastics — Compression-moulded sheets of polyethylene (PE-UHMW, PE-HD) — Requirements and test methods

1 Scope

This document specifies the requirements and test methods for solid flat compression-moulded sheets of polyethylene (PE-UHMW and PE-HD, see ISO 1043-1) without fillers or reinforcing materials. It applies only to thicknesses from 10 mm to 200 mm.

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

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

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics*

ISO 17855-1, *Plastics — Polyethylene (PE) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 21304-1, *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 21304-2, *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Material

Sheets shall consist of PE-UHMW moulding materials as specified in ISO 21304-1 or PE-HD selected from polyethylene (PE) moulding materials as specified in ISO 17855-1, without fillers or reinforcing materials. Materials and additives of unknown identity shall not be used.

NOTE Legal conditions can necessitate a specific choice of moulding material (see 5.3.2).

5 Requirements

5.1 Appearance

Sheets shall have smooth surfaces. Small grooves and any resultant irregularities in the thicknesses of sheets are acceptable as long as the requirements specified in 6.2 are fulfilled. Sheets shall be examined in accordance with 6.3.

Where agreed between the interested parties, sheets with a smooth machined surface may be supplied.

Sheets shall be substantially free from bubbles, blowholes and other inhomogeneities which would make them unfit for the intended use. Specific requirements with respect to this internal integrity shall be agreed upon between the interested parties. Sheets shall be examined in accordance with 6.2.

5.2 Dimensional tolerances

5.2.1 Thickness

For any individual sheet, the thickness tolerance with reference to the nominal thickness shall be as specified in Table 1. Testing shall be in accordance with 6.4.1.

Table 1 — Tolerances on thickness of sheet

Values in millimetres

Nominal thickness h_n	Tolerance			
	PE-UHMW		PE-HD	
			High MW	Low MW
	Group 1.1	Group 1.2	Group 2.1	Group 3.1
$10 \leq h_n \leq 20$	$^{+3}_{0}$	$^{+3}_{0}$	$^{+3}_{0}$	$^{+3}_{0}$
$20 < h_n \leq 40$	$^{+5}_{0}$	$^{+5}_{0}$	$^{+5}_{0}$	$^{+5}_{0}$
$40 < h_n \leq 60$	$^{+6}_{0}$	$^{+6}_{0}$	$^{+6}_{0}$	$^{+6}_{0}$
$60 < h_n \leq 80$	$^{+8}_{0}$	$^{+8}_{0}$	$^{+8}_{0}$	$^{+8}_{0}$
$80 < h_n \leq 100$	$^{+10}_{0}$	$^{+10}_{0}$	$^{+10}_{0}$	$^{+10}_{0}$
$100 < h_n \leq 120$	$^{+12}_{0}$	$^{+12}_{0}$	$^{+12}_{0}$	$^{+12}_{0}$
$120 < h_n \leq 150$	$^{+14}_{0}$	$^{+14}_{0}$	$^{+14}_{0}$	$^{+14}_{0}$
$150 < h_n \leq 200$	$^{+16}_{0}$	$^{+16}_{0}$	$^{+16}_{0}$	$^{+16}_{0}$

5.2.2 Length and width

The nominal length, l_n, and nominal width, b_n, of sheets shall be as agreed between the interested parties.

5.2.3 Rectangularity

For any individual sheet, selected at random from any delivery, the rectangularity tolerance, expressed as the difference in length of the diagonals, $|d_1 - d_2|$ (see Figure 1), shall be in accordance with Table A.1.

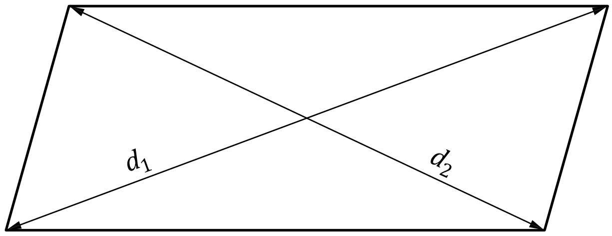


Figure 1 — Difference between lengths of diagonals, $|d_1 - d_2|$

Testing shall be in accordance with 6.4.3.

5.3 Properties

5.3.1 Physical properties

Requirements for physical properties are given in Table 2.

Table 2 — Physical properties

Properties	Unit	Requirements (average values)				Test method subclause
		PE-UHMW		PE-HD		
		Group 1.1	Group 1.2	Group 2.1	Group 3.1	
Density	g/cm^3	0,920 to 0,945	0,920 to 0,945	0,945 to 0,960	0,940 to 0,965	6.5
Abrasion	—	70 to < 90	90 to 110	200 to 450	500 to 1 000	6.6
Tensile stress at yield	MPa	>17	>17	>19	>19	6.7
Tensile strain at yield	%	>8	>8	>8	>8	6.7
Modulus of elasticity in tension	MPa	>500	>600	>800	>700	6.8
Impact strength of double-notched specimens	kJ/m^2	>80	>170	>15	>5	6.9.1
Charpy impact strength of notched specimens	kJ/m^2	No breaks	No breaks	No breaks	> 9	6.9.2
MFR: 190 °C/5 kg	g/10 min	Not measurable	Not measurable	<0,1	0,3 to 0,7	6.10
MFR: 190 °C/21,6 kg	g/10 min	Not measurable	Not measurable	<3	7 to 20	6.10

5.3.2 Physiological behaviour

Any relevant legislation for physiological behaviour shall be taken into consideration.

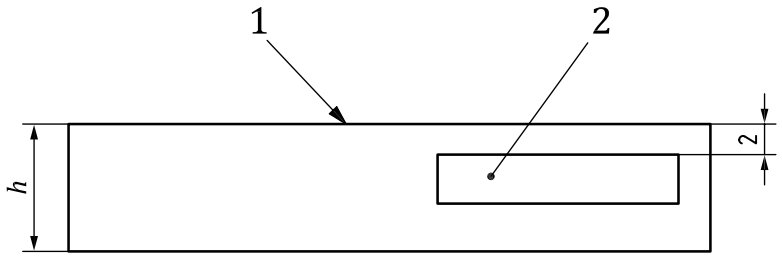
6 Test methods

6.1 Test specimens

6.1.1 Preparation of test specimens

For sheets of thickness ≥ 10 mm but ≤ 20 mm, the test specimens shall be taken as shown in Figure 2, and for sheets of thickness >20 mm but ≤ 200 mm they shall be taken as shown in Figure 3.

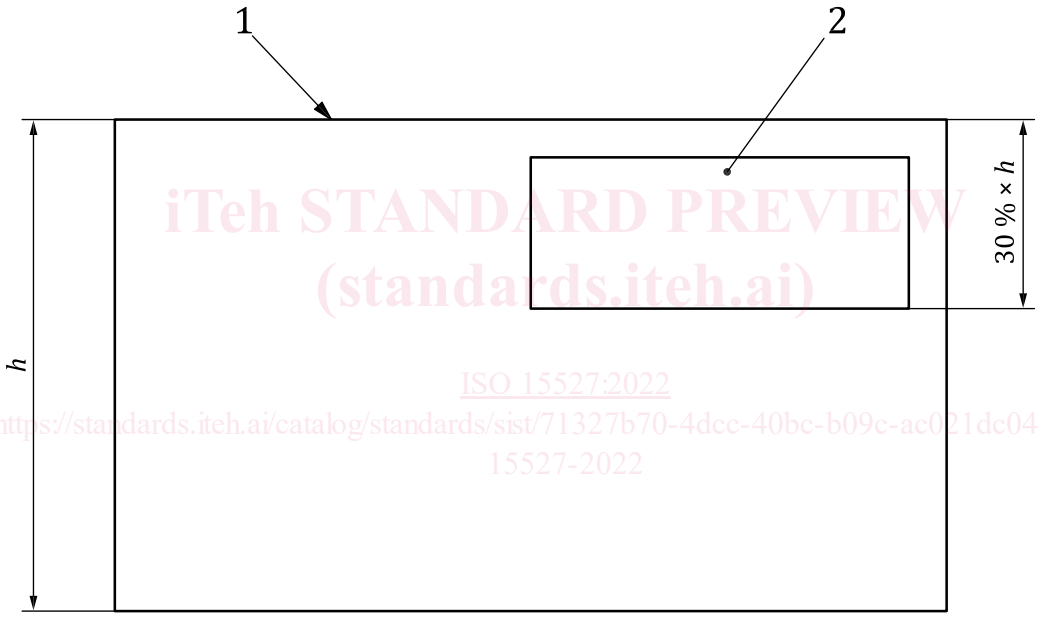
Dimensions in millimetres



Key

1 surface of sheet
2 test specimen
h sheet thickness

Figure 2 — Taking test specimens from sheets of thickness ≥ 10 mm but ≤ 20 mm



Key

1 surface of sheet
2 test specimen
h sheet thickness

Figure 3 — Taking test specimens from sheets of thickness > 20 mm but ≤ 200 mm

The surfaces of the test specimens shall be free from damage and faults in order to avoid notch effects. Should any burrs occur on the test specimens during machining, these shall be eliminated without damaging the surfaces of the specimens. If required, the cut edges shall be finished with abrasive paper (grain size 220 or finer), the direction of abrasion being along the length of the test specimens.

6.1.2 Conditioning

All test specimens shall be conditioned for at least 16 h at 23 °C ± 2 °C in accordance with ISO 291 or as specified in the appropriate material standard. Shorter conditioning times may be used by agreement between the interested parties when it can be shown that there is no significant difference in the results obtained.

6.1.3 Testing

Testing shall be carried out in standard atmosphere 23/50 as specified in ISO 291 or as specified in the appropriate material standard, unless otherwise agreed between the interested parties or specified in the individual test standards.

6.2 Delivery condition

Sheets shall be visually examined when delivered to ensure freedom from mechanical damage or other obvious defects. Sheets can be inspected by ultrasonic or X-ray methods where required.

6.3 Appearance

Where possible, sheets shall be examined for visual defects by transmitted light using a suitable light source. Otherwise, sufficiently bright reflected light shall be used. Any defects thus identified shall be compared with the agreed specification (which may be either a written specification or in the form of reference samples) and classified accordingly.

6.4 Dimensions

6.4.1 Thickness, h

The thickness, h, shall be measured using suitable calibrated equipment with an uncertainty of measurement <0,10 mm.

6.4.2 Length, l, and width, b

The length, l, and width, b, shall be measured to the nearest 1 mm using suitable equipment. Measurements shall be made directly across the surface of the sheet and along the cut edge.

6.4.3 Rectangularity

The rectangularity, expressed as the difference between the lengths of the diagonals, $|d_1 - d_2|$, as shown in Figure 1, shall be measured to the nearest 1 mm using a graduated ruler or tape measure.

6.5 Density

The density shall be determined in accordance with the appropriate part of ISO 1183.

6.6 Determination of abrasion properties

Preparation of test specimens and abrasion testing shall be carried out in accordance with Annex B.

6.7 Tensile stress at yield, σ_y, and tensile strain at yield, ε_y

The tensile stress at yield, σ_y, and tensile strain at yield, ε_y, shall be determined using at least five type 1B test specimens in each direction in accordance with ISO 527-2, using a test speed of 50 mm/min ± 5 mm/min.

6.8 Modulus of elasticity in tension, E_t

The modulus of elasticity in tension, E_t, shall be determined using at least five type 1B test specimens in each direction in accordance with ISO 527-2, using a test speed of 1 mm/min ± 0,2 mm/min.

6.9 Impact strength of notched specimens

6.9.1 Charpy impact strength of double-notched specimens

The Charpy impact strength of double-notched specimens shall be determined in accordance with ISO 21304-2.

6.9.2 Charpy impact strength of single-notched specimens, a_{cN}

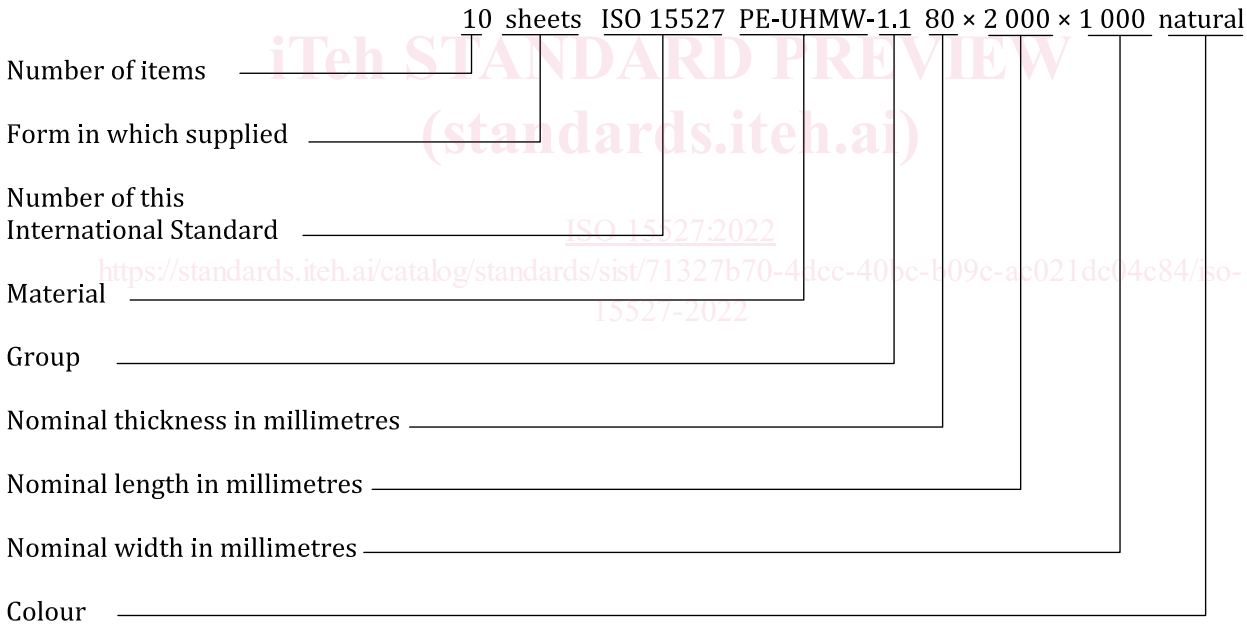
The Charpy impact strength of notched specimens, a_{cN}, shall be determined in accordance with ISO 179-1 (method 1eA), using at least 10 test specimens at 23 °C ± 2 °C.

6.10 Melt mass-flow rate (MFR)

If appropriate for the material being evaluated, the melt mass-flow rate shall be determined in accordance with ISO 1133-1 at a temperature of 190 °C and load of 5 kg, and at a temperature of 190 °C and load of 21,6 kg.

7 Designation and order specification

Example for PE-UHMW sheets:



Designation: 10/sheets/ISO 15527/PE-UHMW-1.1/80 × 2 000 × 1 000/natural

8 Marking

Sheets that conform to this document may be marked with the following information:

a) the manufacturer's name, trade mark or identification mark;

b) the designation and order specification: number of this document/material/dimensions/colour (e.g. ISO 15527:2022/PE-UHMW-1.1/80 × 2 000 × 1 000/natural);

c) the date of manufacture/batch number;

d) further information agreed between interested parties.