
**Extruded sheets of impact-modified
polystyrene (PS-I) — Requirements and test
methods**

*Plaques extrudées en polystyrène modifié résistant au choc (PS-I) —
Prescriptions et méthodes d'essai*

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[ISO 14631:1999](#)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 14631 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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Throughout the text of this standard, read “..this European Standard...” to mean “...this International Standard...”.

Annexes A and B of this International Standard are for information only.

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Foreword

The text of EN ISO 14631:1999 has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 61 "Plastics".

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of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.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

Annex A and Annex B are informative.

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1 Scope

This standard specifies the requirements and test methods for solid flat extruded sheets of impact-modified polystyrene (PS-I¹) without fillers and reinforcing materials. This standard applies only to thickness 0,25 mm to 20,0 mm in accordance with clause 3. This standard also applies to PS-I sheet in roll form.

2 Normative References

This European standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 179	Plastics – Determination of Charpy impact strength (ISO 179:1993)
EN ISO 291	Plastics – Standard atmospheres for conditioning and testing (ISO 291:1997)
EN ISO 306	Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST) (ISO 306:1994)
EN ISO 527-1	Plastics – Determination of tensile properties – Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)
EN ISO 527-2	Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr 1:1994)
EN ISO 2039-1	Plastics – Determination of hardness – Part 1: Ball indentation method (ISO 2039-1:1993)
EN ISO 2818	Plastics – Preparation of test specimens by machining (ISO 2818:1994)
EN ISO 6603-1	Plastics – Determination of multiaxial impact behaviour of rigid plastics – Part 1: Falling dart method (ISO 6603-1:1985)
ISO 1043-1	Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics
ISO 1183	Plastics - Methods for determining the density and relative density of non-cellular plastics
ISO 2897-1	Plastics - Impact-resistant polystyrene (PS-I) moulding and extrusion materials - Part 1: Designation system and basis for specification
ISO 11 501	Plastics – Film and sheeting - Determination of dimensional change on heating

¹ Abbreviation PS-I see ISO 1043-1

3 Material

Sheets shall be made of PS-I extrusion compounds designated by ISO 2897-1 without filler and reinforcing material. Extrusion compounds can contain additives such as processing aids, stabilizers, flame protective agents and colorants. Compounds and additives of unknown identity shall not be used.

NOTE: Legal conditions can cause a specific choice of extrusion compounds (see 4.3.3).

4 Requirements

4.1 Appearance

Sheets shall be substantially free from bubbles, voids, cracks, visible impurities and other defects which would make them unfit for the intended use. Surfaces shall be substantially smooth, if not embossed, and free from grooves, sink marks or damages. Colorants shall be homogeneously distributed throughout the material. Slight colour differences based on extrusion compounds and processing are admissible. Admissible variations in any of the above as well as gloss level specifications, if required, shall be agreed between the interested parties. Sheets shall be examined in accordance with 5.3.

4.2 Dimensional tolerances

4.2.1 Thickness

Within any delivery of sheets, the maximum thickness difference from the nominal, Δh_1 , in millimetres shall fall within the range:

$$|\Delta h_1| \leq (0,03 \text{ mm} + 0,04 \times h_n) \quad (1)$$

where h_n is the nominal sheet thickness in millimetres.

Within any individual sheet, the maximum thickness variation from the average actual value, Δh_2 , in millimetres, shall fall within the range:

$$|\Delta h_2| \leq (0,03 \text{ mm} + 0,02 \times h_n) \quad (2)$$

Testing shall be in accordance with 5.4.1.

4.2.2 Length and width

Nominal length, l_n , and nominal width, b_n , of sheets shall be agreed between the interested parties. Unless agreed differently, the length is in the direction of extrusion. For any individual sheet selected at random from any delivery, the tolerances of length and width shall be in accordance with table 1. Testing shall be in accordance with 5.4.2.

Table 1: Tolerances for length , l , and width , b , of sheet

Nominal dimension D_n	Tolerances	
	length	width
$D_n \leq 1000$	+ 3 - 1	+ 2 - 1
$D_n > 1000$	+ $3 \times 10^{-3} \times l_n$ - 1	+ $2 \times 10^{-3} \times b_n$ - 1

For rolled sheets the minimum length is the nominal length.

4.2.3 Rectangularity

For any individual sheet, selected at random from any delivery, the rectangularity tolerance, expressed as the difference of length of diagonals ($|d_1 - d_2|$, see figure 1), shall fall within the range:

$$|d_1 - d_2| \leq 2 \times 10^{-3} \times \sqrt{l_n^2 + b_n^2} \quad (3)$$

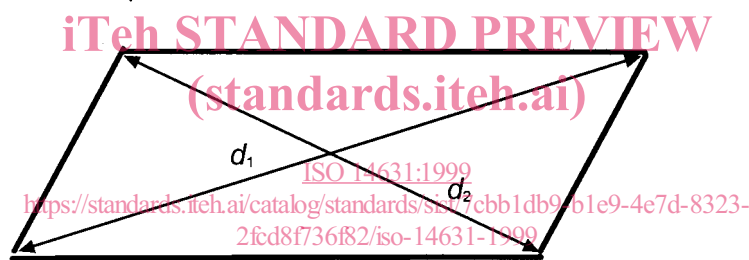


Figure 1: Difference of length of diagonals ($|d_1 - d_2|$)

Testing shall be in accordance with 5.4.3.

4.2.4 Bow of sheets in rolled form

For sheets in rolled form, a maximum bow of 20 mm in 10 m length is permissible. Testing shall be in accordance with 5.4.4

4.3 Properties

The basic mechanical and thermal properties shall be as described below. Guide values of other properties of extruded PS-I sheets are given in tables A.1 and A.2 of the informative annex A.

4.3.1 Mechanical and thermal properties

Table 2: Mechanical and thermal properties

Properties	Unit	Minimum requirements for			Test method subclause
		PS-NI*	PS-RI*	PS-HI*	
Mechanical properties					
Tensile stress at yield, σ_Y	MPa	≥ 20	≥ 17	≥ 13	5.6.1
Nominal tensile strain at break, ϵ_{tB}	%	≥ 20	≥ 30	≥ 35	5.6.2
Modulus of elasticity in tension, E_t	MPa	≥ 2100	≥ 1600	≥ 1250	5.6.3
Charpy impact strength of unnotched specimens, a_{cU} **	kJ/m ²	≥ 30	≥ 35	≥ 40	5.6.4
Charpy impact strength of notched specimens, a_{cN}	kJ/m ²	≥ 3	≥ 5	≥ 7	5.6.5
50 % impact-failure energy, E_{50} at $h_n = 4$ mm	J	≥ 10	≥ 20	≥ 30	5.6.6
Ball indentation hardness H 358/30	MPa	≥ 100	≥ 70	≥ 60	5.6.7
Thermal properties					
Vicat softening temperature VST/B/50	°C	75 to 103	70 to 103	65 to 103	5.7.1
* ISO 1043-1 symbols: N: normal; R: raised; H: high					
** Only valid for nominal sheet thickness $h_n \geq 4$ mm (see also 5.1.1)					

4.3.2 Behaviour after heating

The maximum shrinkage in the direction of extrusion shall not exceed the values given in table 3 when measured using the method in 5.7.2 and the conditions given in table 5. The test specimens shall be substantially free from bubbles or cracks after heating.

Table 3: Maximum shrinkage for thermoforming applications

Nominal thickness h_n	0,25 mm	0,5 mm	1 mm	2 mm	4 mm	8 mm	> 8 mm
Max. shrinkage in the direction of extrusion	35 %	22 %	16 %	12 %	8 %	6 %	not relevant

Intermediate values for other sheet thicknesses can be calculated by interpolation.

4.3.3 Physiological behaviour

Relevant legislation for physiological behaviour shall be taken into consideration.

5 Test Methods

5.1 Test specimens

5.1.1 Preparation of test specimens

Representative test specimens shall be cut longitudinally and transversely evenly distributed over the length and width of the sheet. From a sheet in roll form, a 2 m sample shall be cut from the end of the roll to provide test specimens. 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 production these shall be eliminated without damaging the surfaces of the test specimen. If required, the cut edges shall be finished with abrasive paper (grain no. 220 or finer), the direction of abrasion being along the length of the test specimens. If it is necessary to machine the sheet to reduce it to the thickness required, one original surface shall be left intact. In particular, test specimens over 4,2 mm thick intended to be used in the tests described in 5.6.1 to 5.6.6 shall be machined down on one side to a thickness of $4,0 \pm 0,2$ mm in accordance with EN ISO 2818.

5.1.2 Conditioning **iTeh STANDARD PREVIEW**

Any production quality control test specimens shall be conditioned for at least 16 h at standard atmosphere (23/50) in accordance with EN ISO 291. Shorter conditioning times may be used by agreement with the interested parties when it can be shown that there is no significant difference in the results obtained.

5.1.3 Testing

Testing shall be carried out at standard atmosphere (23/50) in accordance with EN ISO 291, unless agreed differently between the interested parties or specified in the individual testing standards.

5.2 Delivery condition

Surfaces and cutting edges should be visually examined for bubbles, voids, cracks, notches and swarf.

5.3 Appearance

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