
**Plastics — Extruded sheets of impact-
modified acrylonitrile-styrene copolymers
(ABS, AEPDS and ASA) — Requirements
and test methods**

*Plastiques — Plaques extrudées en copolymères d'acrylonitrile-styrène
modifiés choc (ABS, AEPDS ou ASA) — Exigences et méthodes
d'essai*

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

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Plastics — Extruded sheets of impact-modified acrylonitrile-styrene copolymers (ABS, AEPDS and ASA) — Requirements and test methods

1 Scope

This International Standard specifies the requirements and test methods for solid flat extruded sheets of impact-modified acrylonitrile-styrene copolymer materials: acrylonitrile-butadiene-styrene (ABS), acrylonitrile-(ethylene-propylene-diene)-styrene (AEPDS) (commonly known as AES) and acrylonitrile-styrene-acrylate (ASA), without fillers or reinforcing materials. This International Standard also applies to ABS, AEPDS and ASA sheet in rolled form. It applies only to thicknesses from 0,25 mm to 20,0 mm.

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*

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

<http://www.iso.org/obp/ui/#iso:code:38100:179-2>
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ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 306:2004, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

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

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

ISO 2039-1, *Plastics — Determination of hardness — Part 1: Ball indentation method*

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

ISO 2580-1, *Plastics — Acrylonitrile-butadiene-styrene (ABS) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 6402-1, *Plastics — Acrylonitrile-styrene-acrylate (ASA), acrylonitrile-(ethylene-propylene-diene)-styrene (AEPDS) and acrylonitrile-(chlorinated polyethylene)-styrene (ACS) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 6603-1:2000, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 1: Non-instrumented impact testing*

ISO 11501, *Plastics — Film and sheeting — Determination of dimensional change on heating*

3 Material

Sheets shall be made of either ABS extrusion materials as defined in ISO 2580-1 or AEPDS (AES) or ASA extrusion materials as defined in ISO 6402-1, without fillers or reinforcing materials. The extrusion materials 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 may necessitate a specific choice of extrusion material (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 damage. Colorants shall be homogeneously distributed throughout the material. Slight colour variations due to variations in the extrusion compound or processing conditions are admissible. The exact extent of 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 variation from the nominal value, Δh_1 , in millimetres, shall satisfy the requirement

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

where h_n is the nominal sheet thickness, in millimetres

Within any individual sheet, the maximum thickness variation, Δh_2 , in millimetres, shall satisfy the requirement

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

Testing shall be in accordance with 5.4.1.

4.2.2 Length and width

The nominal length, l_n , and nominal width, b_n , of sheets shall be as agreed between the interested parties. Unless agreed differently, the length shall be in the direction of extrusion.

For any individual sheet selected at random from any delivery, the tolerances on length and width shall be in accordance with Table 1. Testing shall be in accordance with 5.4.2.

Table 1 — Tolerances on length and width of sheets

Values in millimetres

Nominal dimension D_n	Tolerances	
	Length	Width
$D_n \leq 1\ 000$	+3 -1	+2 -1
$D_n > 1\ 000$	$+3 \times 10^{-3} \times l_n$ -1	$+2 \times 10^{-3} \times b_n$ -1

For rolled sheets, the minimum length shall be the nominal length.

4.2.3 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 satisfy the requirement

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

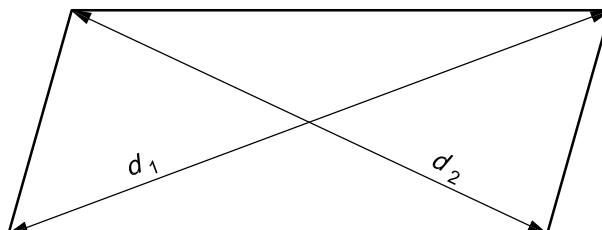


Figure 1 — Difference in length of diagonals, $|d_1 - d_2|$

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 a 10 m length is permissible. Testing shall be in accordance with 5.4.4.

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4.3 Properties

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4.3.1 Mechanical and thermal properties

The basic mechanical and thermal properties shall be as specified in Tables 2 and 3. Guide values of other properties of extruded ABS, AEPDS (AES) and ASA sheets are given in Tables A.1 and A.2 in Annex A.

Table 2 — Mechanical and thermal properties — ABS

Property	Unit	Requirements (average values) for		Test method subclause
		ABS-NI ^a	ABS-HI ^a	
Tensile stress at yield, σ_y	MPa	≥ 35	≥ 30	5.6.1
Tensile modulus, E_t	MPa	$\geq 2\,100$	$\geq 1\,800$	5.6.2
Charpy impact strength of unnotched specimens, a_{cu} , at -20 °C ^b	kJ/m ²	≥ 40	≥ 60	5.6.3
Charpy impact strength of notched specimens, a_{cn} , at -20 °C ^b	kJ/m ²	≥ 10	≥ 15	5.6.4
50 % impact-failure energy, E_{50} , at $h_n = 4\text{ mm}$	J	≥ 30	≥ 55	5.6.5
Ball indentation hardness, HB (test load 358 N)	N/mm ²	≥ 80	≥ 60	5.6.6
Thermal properties				
Vicat softening temperature, VST (force 50 N, heating rate 50 °C/h)	°C	90 to 105	85 to 105	5.7.1

^a NI: normal impact, HI: high impact.

^b Only valid for nominal sheet thicknesses $h_n \geq 4\text{ mm}$ (see also 5.1.1).

Table 3 — Mechanical and thermal properties — AEPDS (AES) and ASA

Property		Unit	Requirements (average values) for		Test method subclause
			AEPDS	ASA	
Mechanical properties	Tensile stress at yield, σ_y	MPa	≥ 30	≥ 30	5.6.1
	Tensile modulus, E_t	MPa	$\geq 1\,700$	$\geq 1\,500$	5.6.2
	Charpy impact strength of unnotched specimens, a_{cu} , at $-20\text{ }^\circ\text{C}$ ^a	kJ/m ²	≥ 60	≥ 80	5.6.3
	Charpy impact strength of notched specimens, a_{cn} , at $-20\text{ }^\circ\text{C}$ ^a	kJ/m ²	≥ 25	≥ 30	5.6.4
	50 % impact-failure energy, E_{50} , at $h_n = 4\text{ mm}$	J	≥ 60	≥ 60	5.6.5
	Ball indentation hardness, HB (test load 358 N)	N/mm ²	≥ 70	≥ 60	5.6.6
Thermal properties	Vicat softening temperature, VST (force 50 N, heating rate $50\text{ }^\circ\text{C/h}$)	$^\circ\text{C}$	85 to 105	85 to 105	5.7.1

^a Only valid for nominal sheet thicknesses $h_n \geq 4\text{ mm}$ (see also 5.1.1).

4.3.2 Behaviour on heating

The maximum shrinkage in the direction of extrusion shall not exceed the values given in Table 4 when measured using the method specified in 5.7.2 under the conditions given in Table 6. The test specimens shall be substantially free from bubbles and cracks after heating.

Table 4 — 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 concerning 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 both longitudinally and transversely from locations evenly distributed over the length and width of the sheet. With sheets in rolled form, a 2 m sample shall be cut from the end of the roll to prepare test specimens. The surfaces of the test specimens shall be free from damage and faults in order to avoid notch effects. Should any burrs be formed on the test specimens during preparation, 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. 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 $4,0\text{ mm} \pm 0,2\text{ mm}$ in accordance with ISO 2818.

5.1.2 Conditioning

Any production quality control test specimens shall be conditioned for at least 16 h 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.

5.1.3 Test conditions

Testing shall be carried out under conditions which are in accordance with ISO 291, unless otherwise agreed between the interested parties or specified in the individual test standards.

5.2 Delivery condition

Surfaces and cut edges shall 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 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 the sheets classified accordingly.

5.4 Dimensions

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5.4.1 Thickness, h

The thickness, h , shall be measured using suitable calibrated equipment meeting the requirements given in Table 5.

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Table 5 — Error limits of equipment

Values in millimetres

Nominal thickness, h_n	Error limit
$0,25 \leq h_n < 1,0$	$\leq +0,01$
$1,0 \leq h_n < 10,0$	$\leq +0,05$
$10,0 \leq h_n \leq 20,0$	$\leq +0,1$

5.4.2 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.

5.4.3 Rectangularity

For flat sheets, 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.

5.4.4 Bow of sheets in rolled form

For sheets in rolled form, the bow shall be determined after the sheets have been pulled free from the rolls and measured against a straight edge. The bow shall be measured to the nearest 1 mm using suitable calibrated equipment.