INTERNATIONAL STANDARD

ISO 11833-1

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Plastics — Unplasticized poly(vinyl chloride) sheets — Types, dimensions and characteristics —

Part 1:
Sheets of thickness not less than 1 mm

Plastiques — Feuilles en poly(chlorure de vinyle) non plastifié — Types, dimensions et caractéristiques —

Partie 1: Plaques d'épaisseur non inférieure à 1 mm

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.

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 11833-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

ISO 11833 consists of the following parts, under the general title *Unplasticized poly(vinyl chloride) sheets — Types, dimensions and characteristics*:

— *Part 1: Sheets of thickness not less than 1 mm*

— *Part 2: Sheets of thickness less than 1 mm*

Annexes A and B of this part of ISO 11833 are for information only.

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Plastics — Unplasticized poly(vinyl chloride) sheets — Types, dimensions and characteristics —

Part 1:
Sheets of thickness not less than 1 mm

1 Scope

1.1 This part of ISO 11833 specifies the requirements for flat extruded sheets and pressed sheets of unplasticized poly(vinyl chloride) (PVC-U) and the test methods to be used to measure the required values.

1.2 It applies only to sheets of thickness not less than 1,0 mm.

1.3 It does not cover biaxially stretched PVC-U sheets.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11833. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11833 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 75-2:1993, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite.*

ISO 178:1993, *Plastics — Determination of flexural properties.*

ISO 179-1:—[1)], *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test.*

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*

ISO 527-1:1993, *Plastics — Determination of tensile properties — Part 1: General principles.*

ISO 527-2:1993, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics.*

ISO 899-2:1993, *Plastics — Determination of creep behaviour — Part 2: Flexural creep by three-point loading.*

ISO 1163-1:1995, *Plastics — Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials — Part 1: Designation system and basis for specifications.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 2039-1:1993, *Plastics — Determination of hardness — Part 1: Ball indentation method.*

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1) To be published. (Revision of ISO 179:1993)

ISO 2818:1994, *Plastics — Preparation of test specimens by machining.*

ISO 2859-1:—[2], *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 4593:1993, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning.*

ISO 11501:1995, *Plastics — Film and sheeting — Determination of dimensional change on heating.*

ISO 13468-1:1996, *Plastics — Determination of the total luminous transmittance of transparent materials — Part 1: Single-beam instrument.*

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials.*

3 Material

Sheets shall be fabricated from unplasticized PVC compounds as defined in ISO 1163-1:1995, subclause 1.3. Compounds may contain additives such as stabilizers, lubricants, processing aids, impact modifiers, fillers, flame retardants and colourants. Compounds and additives of unknown identity and composition shall not be used for the processing of sheets.

NOTE — Legal considerations may cause a specific choice of compound.

4 Classification

Sheets are classified into the following 15 groups by the numerical values of the three most important properties, i.e. the tensile stress at yield, the Charpy impact strength and the Vicat softening temperature (see table 5):

Extruded sheets: Group 1	Pressed sheets: Group 1
Extruded sheets: Group 2	Pressed sheets: Group 2
Extruded sheets: Group 3	Pressed sheets: Group 3
Extruded sheets: Group 4	Pressed sheets: Group 4
Extruded sheets: Group 5	Pressed sheets: Group 6
Extruded sheets: Group 6	Pressed sheets: Group 7
Extruded sheets: Group 7	Pressed sheets: Group 8
Extruded sheets: Group 8	

5 Requirements

5.1 Masking

Protection of the sheet surface with a suitable material shall be agreed between the interested parties as required.

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2) To be published. (Revision of ISO 2859-1:1989)

5.2 Appearance

The surface shall be free of noticeable flaws, cracks, mottling, voids, bubbles, impurities and other defects which are not acceptable for the application envisaged. The sheet shall have a smooth surface, except for embossed sheets which shall have a uniform pattern.

5.3 Colour

Colourants and pigments shall be distributed uniformly throughout the material. Admissible differences in colour within a sheet and amongst sheets shall be agreed between the interested parties as required.

5.4 Dimensions

5.4.1 Length and width

The nominal length and width of sheets shall be agreed between the interested parties. For any individual sheet selected at random from any delivery, the tolerances shall be as specified in table 1.

Table 1 — Tolerances on length and width

Dimensions and tolerances in millimetres

Nominal dimension	Tolerance			
	Length		Width	
	Extruded	Pressed	Extruded	Pressed
Up to 500	$^{+3}_{0}$		$^{+3}_{0}$	
Over 500 to 1 000	$^{+4}_{0}$		$^{+4}_{0}$	
Over 1 000 to 1 500	$^{+5}_{0}$	$^{+4}_{0}$	$^{+5}_{0}$	$^{+4}_{0}$
Over 1 500 to 2 000	$^{+6}_{0}$		$^{+6}_{0}$	
Over 2 000 to 4 000	$^{+7}_{0}$		$^{+7}_{0}$	

5.4.2 Rectangularity

For any individual sheet selected at random from any delivery, the tolerance on rectangularity, expressed as the difference in length of the diagonals, shall be as specified in table 2.

Table 2 — Tolerance on rectangularity

Dimensions and tolerances in millimetres

Nominal dimensions (length × width)	Tolerance (difference between diagonals)	
	Extruded	Pressed
1 800 × 910	7	5
2 000 × 1 000	7	5
2 440 × 1 220	9	7
3 000 × 1 500	11	8
4 000 × 2 500	17	13

The tolerances specified in table 2 assume that the length and width of the sheet comply with table 1.

Tolerances on sheets of other nominal dimensions shall be calculated, in millimetres, using the following equations and rounded to the nearest integer:

Extruded sheet:

$$\left|\overline{AC} - \overline{BD}\right| = \sqrt{(\overline{AB} + 4\overline{BC}/1000)^2 + \overline{BC}^2} - \sqrt{(\overline{AB} - 4\overline{BC}/1000)^2 + \overline{BC}^2}$$

Pressed sheet:

$$\left|\overline{AC} - \overline{BD}\right| = \sqrt{(\overline{AB} + 3\overline{BC}/1000)^2 + \overline{BC}^2} - \sqrt{(\overline{AB} - 3\overline{BC}/1000)^2 + \overline{BC}^2}$$

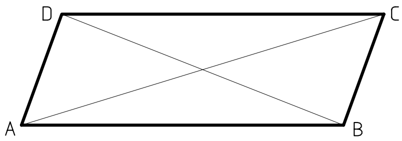


Figure 1 — Deviation from rectangularity

5.4.3 Thickness

The tolerance on the thickness shall be as specified in table 3 for general-purpose applications (T_1) or as specified in table 4 for specific applications (T_2), as agreed between the interested parties.

Table 3 — Tolerances on thickness for general-purpose applications (T_1)

Nominal thickness mm	Tolerance %	
	Extruded	Pressed
1 to 5	± 13	± 15
over 5 to 20	± 10	± 10
over 20	± 7	± 7

Table 4 — Tolerances on thickness for specific applications (T_2)

	Tolerance mm
Extruded sheet	± (0,1 + 0,03 × nominal thickness)
Pressed sheet	± (0,1 + 0,05 × nominal thickness)

5.5 Basic properties

The basic mechanical, thermal and optical properties of sheets of each group shall be as specified in table 5.

Table 5 — Basic properties of sheets

Property	Test method	Unit	Requirements (average values)														
			Extruded sheets								Pressed sheets						
			Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 1	Group 2	Group 3	Group 4	Group 6	Group 7	Group 8
Tensile stress at yield	ISO 527-2 Type 1B	MPa	⩾ 60	⩾ 55	⩾ 50	⩾ 45	⩾ 50	⩾ 45	⩾ 40	⩾ 50	⩾ 60	⩾ 50	⩾ 50	⩾ 45	⩾ 45	⩾ 40	⩾ 50
Nominal strain at break	ISO 527-2 Type 1B	%	⩾ 5	⩾ 15	⩾ 15	⩾ 20	⩾ 15	⩾ 20	⩾ 20	⩾ 20	⩾ 15	⩾ 20	⩾ 10	⩾ 20	⩾ 30	⩾ 20	⩾ 15
Modulus of elasticity in tension	ISO 527-2 Type 1B	MPa	⩾3200	⩾3000	⩾2500	⩾2000	⩾2300	⩾2500	⩾1800	⩾2500	⩾3000	⩾2500	⩾2500	⩾2500	⩾2000	⩾1800	⩾2500
Charpy impact strength of notched specimens	ISO 179-1 Type 1epA	kJ/m^2	⩾ 2	⩾ 2	⩾ 2	⩾ 1	⩾ 5	⩾ 5	⩾ 80	⩾ 2	⩾ 2	⩾ 5	⩾ 2	⩾ 1	⩾ 10	⩾ 80	⩾ 2
Vicat softening temperature	ISO 306 Method B	°C	⩾ 70	⩾ 75	⩾ 70	⩾ 60	⩾ 75	⩾ 72	⩾ 70	⩾ 95	⩾ 78	⩾ 75	⩾ 75	⩾ 65	⩾ 72	⩾ 70	⩾ 95
Dimensional change on heating	Subclause 6.5.2	%	Nominal thickness 1,0 mm to 2,0 mm: from –10 to +10 Nominal thickness over 2,0 mm to 5,0 mm: from –5 to +5 Nominal thickness over 5,0 mm to 10,0 mm: from –4 to +4 Nominal thickness over 10,0 mm: from –4 to +4								from –3 to +3						
Total luminous transmittance [1]	ISO 13468-1	%	Nominal thickness 2,0 mm or less: ⩾ 82 Nominal thickness over 2,0 mm to 6,0 mm: ⩾ 78 Nominal thickness over 6,0 mm to 10,0 mm: ⩾ 75 Nominal thickness over 10,0 mm: —														

1) Applicable to colourless transparent sheets only.

5.6 Other mechanical and physical properties

Requirements for the properties in table 6 shall be agreed between the interested parties as required.

Table 6 — Other mechanical and physical properties

Property	Test method	Unit
Charpy impact strength of unnotched specimens at 0 °C and –20 °C	ISO 179-1 Type 1eU/pendulum energy 4 J	kJ/m^2
Temperature of deflection under load	ISO 75-2 Method A	°C
Creep modulus in flexure under stress of 5 MPa	ISO 899-2 40 °C	MPa
Density	ISO 1183	g/cm^3
Flexural strength	ISO 178 b = 35 mm	MPa
Ball indentation hardness	ISO 2039-1	N/mm^2
Volume resistivity	IEC 60093	Ω·cm

5.7 Chemical and physiological properties

5.7.1 Flammability

Requirements for flammability shall be agreed between the interested parties as required. Relevant national and international standards shall be considered in the agreement.

5.7.2 Chemical resistance

Requirements for chemical resistance for specific applications shall be agreed between the interested parties as required.

5.7.3 Physiological behaviour

Requirements for physiological behaviour shall be agreed between the interested parties as required. The relevant legislation shall be taken into consideration if the sheet will come into contact with food.

6 Test methods

6.1 General

6.1.1 Sampling

Take a sample sufficient to investigate the compliance of the material with this specification. The sampling procedure given in ISO 2859-1 is recommended.

6.1.2 Preparation of specimens

Prepare all specimens in accordance with ISO 2818. The surface of the specimens shall be free of any damage or faults in order to avoid notch effects. Should any burrs be present on a specimen, remove them without damaging the surface. If necessary, finish the edges of the machined surfaces with sandpaper. When it is necessary to machine the sheet to reduce the thickness for a particular test, leave one original surface intact.

6.1.3 Conditioning and testing of specimens

Unless otherwise specified in clause 5 or hereafter, carry out testing in one of the standard atmospheres specified in ISO 291, after conditioning the specimens for at least 16 h in the same atmosphere.

6.2 Appearance examination

Examine the original and cut surfaces with the naked eye from a distance of 60 cm for noticeable flaws, cracks, mottling, voids, bubbles, impurities and other defects, inspecting the sheet in the direction opposite to that of the incident light. Ultrasonic or X-ray examination may also be used to detect voids.

6.3 Dimensions

6.3.1 Measure the length, width and diagonals of the sheet to the nearest 1 mm, using a calibrated ruler or tape measure.

6.3.2 Measure the thickness to the nearest 0,01 mm, using a calibrated thickness gauge.

6.4 Mechanical properties

6.4.1 Tensile stress at yield and nominal strain at break

Determine the tensile stress at yield and the nominal strain at break in accordance with ISO 527-2, using at least five type 1B specimens for each direction and a test speed of 50 mm/min.

6.4.2 Modulus of elasticity in tension

Determine the modulus of elasticity in tension in accordance with ISO 527-1 and ISO 527-2, using at least three type 1B specimens for each direction and a test speed of 1 mm/min.

6.4.3 Charpy impact strength of notched specimens

Determine the Charpy impact strength of notched specimens in accordance with ISO 179-1, using at least ten type 1epA specimens cut out in the extrusion direction and at least ten cut out in the transverse direction.

6.5 Thermal properties

6.5.1 Vicat softening temperature

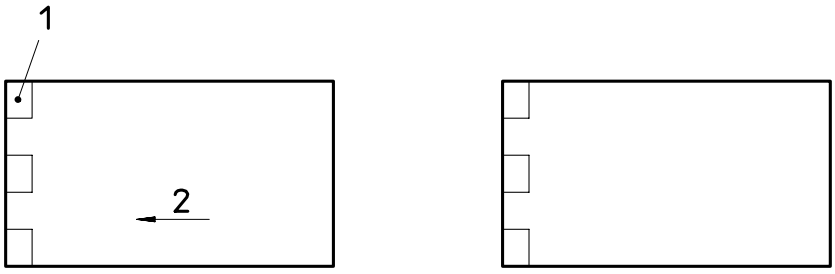
Determine the Vicat softening temperature in accordance with ISO 306, Method B.

6.5.2 Dimensional change on heating and resistance to delamination

Determine the dimensional change on heating and the resistance to delamination by the following method:

6.5.2.1 Specimens

Cut out at least three specimens measuring 120 mm × 120 mm at the locations in the sample sheet shown in figure 2.



a) Extruded sheet b) Pressed sheet

Key

1 Specimen
2 Direction of extrusion

Figure 2 — Locations of specimens