
**Plastics — Unplasticized poly(vinyl
chloride) sheets —**

Part 1:
**Types, dimensions and
characteristics for sheets of thickness
not less than 1 mm**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

*Plastiques — Feuilles en poly(chlorure de vinyle) non plastifié —
Partie 1: Types, dimensions et caractéristiques pour des plaques
d'épaisseur non inférieure à 1 mm*

<https://standards.iteh.ai/catalog/standards/sist/312beb19-a4d9-4d32-857d-93fe1393ca84/iso-11833-1-2019>



iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 11833-1:2019

<https://standards.iteh.ai/catalog/standards/sist/312beb19-a4d9-4d32-857d-93fe1393ca84/iso-11833-1-2019>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definition	2
4 Material	2
5 Classification	2
6 Requirements	2
6.1 Masking.....	2
6.2 Appearance.....	2
6.3 Dimensions.....	3
6.3.1 Length and width.....	3
6.3.2 Rectangularity.....	3
6.3.3 Thickness.....	4
6.4 Basic properties.....	4
6.5 Other mechanical and physical properties.....	6
6.6 Chemical and physiological properties.....	6
6.6.1 Flammability.....	6
6.6.2 Chemical resistance.....	6
6.6.3 Physiological behaviour.....	6
7 Test methods	6
7.1 General.....	6
7.1.1 Sampling.....	6
7.1.2 Preparation of specimens.....	6
7.1.3 Conditioning and testing of specimens.....	7
7.2 Appearance examination.....	7
7.3 Dimensions.....	7
7.4 Mechanical properties.....	8
7.4.1 Tensile stress at yield and nominal strain at break.....	8
7.4.2 Modulus of elasticity in tension.....	8
7.4.3 Charpy impact strength of notched specimens.....	9
7.5 Thermal properties.....	9
7.5.1 Vicat softening temperature.....	9
7.5.2 Dimensional change on heating and resistance to delamination.....	9
7.6 Total luminous transmittance.....	11
7.7 Other mechanical and physical properties.....	11
7.7.1 Charpy impact strength of unnotched specimens.....	11
7.7.2 Temperature of deflection under load.....	11
7.7.3 Creep modulus.....	11
7.7.4 Density.....	11
7.7.5 Flexural strength.....	12
7.7.6 Ball indentation hardness.....	12
7.7.7 Volume resistivity.....	12
8 Marking	12
Annex A (informative) Determination of resistance to delamination of thick pressed sheets using a wedge	13
Annex B (informative) Determination of resistance to delamination of thick pressed sheets by thermal bending	15

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

This fourth edition cancels and replaces the third edition (ISO 11833-1:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

- the title has been editorially revised to read "Plastics — Unplasticized poly(vinyl chloride) sheets — Part 1: Types, dimensions and characteristics for sheets of thickness not less than 1 mm";
- the "colour" requirements (former 5.3) have been incorporated with the "appearance" requirements in [6.2](#) (former 5.2);
- the requirements for measurement at any other temperature (t °C) than 23 °C has been added to [7.3.1](#) (former 6.3.1);
- the method of handling the results of [7.4.1](#), [7.4.2](#) and [7.4.3](#) (former 6.4.1 to 6.4.3) have been added;
- "Testing of sheets with a thickness between 1,0 mm and <1,5 mm shall be subject between the interested parties" has been added in [7.5.1](#) (former 6.5.1);
- a new [Table 7](#) "Frequency and measurement positions of appearance tests and dimensional measurements" has been added and the subsequent tables have been renumbered..

A list of all parts in the ISO 11833 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.

Plastics — Unplasticized poly(vinyl chloride) sheets —

Part 1:

Types, dimensions and characteristics for sheets of thickness not less than 1 mm

1 Scope

This document 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.

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

It does not cover biaxially stretched PVC-U sheets.

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 75-2:2013, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 11833-1:2019

ISO 178, *Plastics — Determination of flexural properties*

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 306:2013, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 472, *Plastics — Vocabulary*

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

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

ISO 21306-1:2019, *Plastics — Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

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

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

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

IEC 62631-3-1, *Dielectric and resistive properties of solid insulating materials — Part 3-1: Determination of resistive properties (DC methods) — Volume resistance and volume resistivity — General method*

3 Terms and definition

For the purposes of this document, the terms and definitions given in ISO 472 apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Material

Sheets shall be fabricated from PVC-U compounds as defined in ISO 21306-1:2019, Clause 1. 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.

5 Classification

iTeh STANDARD PREVIEW

Extruded and pressed sheets are each classified into the following five groups, characterized by type of sheet as well as by the numerical values of the three most important properties, i.e. tensile stress at yield, Charpy impact strength and Vicat softening temperature (see Table 5):

- Group 1: General-purpose grade, <https://standards.iteh.ai/catalog/standards/sist/312beb19-a4d9-4d32-857d-93fe1393ca84/iso-11833-1-2019>
- Group 2: Transparent grade;
- Group 3: High-modulus grade;
- Group 4: High-impact grade;
- Group 5: Heat-resistant grade.

6 Requirements

6.1 Masking

Protection of the sheet surface with a suitable material (for example polyethylene or paper) shall be agreed between the interested parties as required.

6.2 Appearance

The surface shall be free of noticeable flaws, cracks, mottling, voids, bubbles, impurities, colour unevenness (both within one sheet and between sheets) 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. Requirements concerning defects shall be agreed upon between the interested parties.

6.3 Dimensions

6.3.1 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 in millimetres

Nominal dimension d_n	Tolerance on length and width	
	Extruded sheet	Pressed sheet
$d_n \leq 500$	+3 0	+4 0
$500 < d_n \leq 1\,000$	+4 0	
$1\,000 < d_n \leq 1\,500$	+5 0	
$1\,500 < d_n \leq 2\,000$	+6 0	
$2\,000 < d_n \leq 4\,000$	+7 0	

6.3.2 Rectangularity

(standards.iteh.ai)

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](#).

<https://standards.iteh.ai/catalog/standards/sist/312beb19-a4d9-4d32-857d-8213930e1c83/iso-11833-1:2019>

Table 2 — Tolerances on rectangularity

Dimensions in millimetres

Nominal dimensions (length × width)	Tolerance (difference between diagonals)	
	Extruded sheet	Pressed sheet
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 [Formulae \(1\)](#) and [\(2\)](#) and rounded to the nearest integer:

Extruded sheet:

$$|\overline{AC} - \overline{BD}| = \sqrt{(\overline{AB} + 4\overline{BC}/1\,000)^2 + \overline{BC}^2} - \sqrt{(\overline{AB} - 4\overline{BC}/1\,000)^2 + \overline{BC}^2} \quad (1)$$

Pressed sheet:

$$|\overline{AC} - \overline{BD}| = \sqrt{(\overline{AB} + 3\overline{BC}/1\,000)^2 + \overline{BC}^2} - \sqrt{(\overline{AB} - 3\overline{BC}/1\,000)^2 + \overline{BC}^2} \tag{2}$$

where $|\overline{AC} - \overline{BD}|$ is the deviation from rectangularity (see Figure 1).

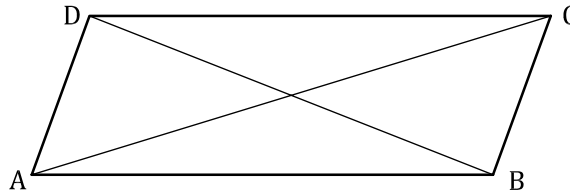


Figure 1 — Deviation from rectangularity

6.3.3 Thickness

The thickness shall be determined in accordance with 7.3.2. The tolerance on the thickness shall be as specified in Table 3 for non-critical applications (T₁) or as specified in Table 4 for critical applications (T₂), as agreed between the interested parties.

Table 3 — Tolerances on thickness for non-critical applications (T₁)

Nominal thickness, <i>d</i> mm	Tolerance ISO 11833-1:2019 %	
	Extruded sheet	Pressed sheet
1 < <i>d</i> ≤ 5	±13	±15
5 < <i>d</i> ≤ 20	±10	±10
<i>d</i> > 20	±7	±7

Tolerances for embossed sheets shall be agreed between interested parties as required.

Table 4 — Tolerances on thickness for critical applications (T₂)

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

Tolerances for embossed sheets shall be agreed between interested parties as required.

6.4 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

Properties	Test method	Unit	Requirements by manufacturing methods and types (average values)											
			Extruded sheets					Pressed sheets						
			Group 1 General purpose	Group 2 Transpar- ent	Group 3 High modulus	Group 4 High impact	Group 5 Heat resistant	Group 1 General purpose	Group 2 Transpar- ent	Group 3 High modulus	Group 4 High impact	Group 5 Heat resistant		
Tensile stress at yield	ISO 527-2 Type 1B	MPa	≥50	≥45	≥60	≥45	≥50	≥50	≥45	≥60	≥50	≥45	≥60	≥50
Nominal strain at break	ISO 527-2 Type 1B	%	≥8	≥5	≥3	≥8	≥10	≥5	≥5	≥8	≥10	≥5	≥8	≥8
Modulus of elasticity in tension	ISO 527-2 Type 1B	MPa	≥2 500	≥2 000	≥3 200	≥2 300	≥2 500	≥2 500	≥2 500	≥3 000	≥2 500	≥2 000	≥2 000	≥2 500
Charpy impact strength of notched specimens	ISO 179-1 Type 1epA	kJ/m ²	≥2	≥1	≥2	≥5	≥2	≥2	≥1	≥2	≥2	≥10	≥2	≥2
Vicat softening temperature	ISO 306:2013 Method B50	°C	≥70	≥60	≥70	≥70	≥85	≥75	≥65	≥78	≥70	≥70	≥90	≥90
Dimensional change on heating	7.5.2	%	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											
Delamination	7.5.2	—	Not applicable											
Total luminous transmittance (Applicable to group 2 only)	ISO 13468-1	%	Thickness of sheets Nominal thickness 2,0 mm or less: Nominal thickness over 2,0 mm to 6,0 mm: Nominal thickness over 6,0 mm to 10,0 mm: Nominal thickness over 10,0 mm:					Class A: General purpose ≥80 ≥71 ≥61 — Class B: High transparency ≥82 ≥78 ≥75 —						

Requirements for embossed sheets shall be agreed between interested parties as required.

6.5 Other mechanical and physical properties

Requirements for the properties in [Table 6](#) shall be agreed between the interested parties as required.

The other mechanical properties shall be determined in accordance with [7.7](#).

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 75-2:2013 Method A	°C
Creep modulus in flexure under stress of 5 MPa	ISO 899-2 40 °C	MPa
Density	ISO 1183-1 or ISO 1183-2	g/cm ³
Flexural strength	ISO 178 <i>b</i> ^a = 35 mm	MPa
Ball indentation hardness	ISO 2039-1	N/mm ²
Volume resistivity	IEC 62631-3-1	Ω·cm
^a <i>b</i> = width of test specimen.		

6.6 Chemical and physiological properties

6.6.1 Flammability

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

6.6.2 Chemical resistance

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

6.6.3 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 is likely to come into contact with food.

7 Test methods

7.1 General

7.1.1 Sampling

Take a sample sufficient to investigate the compliance of the material with this specification. The sampling shall be done in accordance with ISO 2859-1.

7.1.2 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.

7.1.3 Conditioning and testing of specimens

Unless otherwise specified in [Clause 6](#) 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. However, it is not applicable for appearance inspection and dimensions measurement.

7.2 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.

7.3 Dimensions

7.3.1 Measure the length, width and diagonals of the sheet to the nearest 1 mm, using a calibrated ruler or tape measure. For dimension measurement, 23 °C shall be the standard. When measurement is performed at any other temperature (t °C) than 23 °C, the value converted to 23 °C by using [Formula \(3\)](#) shall be adopted.

$$L_{23} = L / \left[1 + 7 \times 10^{-5} \times (t - 23) \right] \quad (3)$$

where

L_{23} is the length or width converted to 23 °C (mm);

t is the temperature at the time of measurement (°C);

L is the length or width measured at t °C (mm);

7×10^{-5} is the linear expansion coefficient of sheet (1/°C).

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

7.3.3 Frequency of measurement and measurement positions.

The frequency of dimensional measurements of the sheet and measurement positions shall be as shown in [Table 7](#).

Table 7 — Frequency and measurement positions of appearance tests and dimensional measurements

Frequency and positions	Extruded sheet (E)	Pressed sheet (P)
Frequency of appearance tests and dimensional measurement	Take at least one specimen from each lot consisting of manufactured products of the same size.	Take at least one specimen from each lot consisting of continuously cut products of the same size.