
Plastics — Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials —

**Part 2:
Preparation of test specimens and
determination of properties**

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Plastiques — Matériaux à base de poly(chlorure de vinyle) non plastifié (PVC-U) pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

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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).

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 9, *Thermoplastic materials*.

This first edition of ISO 21306-2 cancels and replaces ISO 1163-2:1995, which has been technically revised. The main changes compared to the previous edition are as follows:

- ISO 3167 has been replaced by ISO 20753;
- IEC 93 has been replaced by the new editions of IEC 62631-3-1 and of IEC 62631-3-2.

A list of all parts in the ISO 21306 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) (PVC-U) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

This document specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of PVC-U moulding and extrusion materials. Requirements for handling test materials and for conditioning both the test material before moulding and the specimens before testing are given.

The properties required for the designation of PVC-U thermoplastics are given in ISO 21306-1. All properties are intended to be determined by the appropriate methods referred to in this document and values obtained shall be presented as laid down in ISO 10350-1.

The values determined in accordance with this document are not necessarily be identical to those obtained using specimens of different dimensions and/or prepared by different procedures. The values obtained for the properties of a moulding depend on the moulding compound, the shape, the test method and the state of anisotropy. The last-mentioned depends on the gating of the mould and the moulding conditions, for example temperature, pressure and injection rate. Any subsequent treatment is also be considered, for example conditioning or annealing.

The thermal history and the internal stresses of the specimens can strongly influence the thermal and mechanical properties and the resistance to environmental stress cracking, but exert less effect on the electrical properties, which depend mainly on the chemical composition of the moulding compound.

In order to obtain reproducible and comparable test results, the methods of preparation and conditioning, the specimen dimensions and the test procedures specified herein are used. Values determined are not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

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 62, *Plastics — Determination of water absorption*

ISO 75-1, *Plastics — Determination of temperature of deflection under load — Part 1: General test method*

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

ISO 178, *Plastics — Determination of flexural properties*

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

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

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

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ISO 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

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

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

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

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*

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 1183-3, *Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pycnometer method*

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

ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test*

ISO 4589-3, *Plastics — Determination of burning behaviour by oxygen index — Part 3: Elevated-temperature test*

ISO 8256, *Plastics — Determination of tensile-impact strength*

ISO 10350-1, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 20753, *Plastics — Test specimens*

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

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60243-1, *Electrical strength of insulating materials — Test methods — Part 1: Tests at power frequencies*

IEC 60250, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*

IEC 60296, *Fluids for electrotechnical applications — Unused mineral insulating oils for transformers and switchgear*

IEC 60695-11-10, *Fire hazard testing — Part 11-10: Test flames — 50W horizontal and vertical flame test method*

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*

IEC 62631-3-2, *Dielectric and resistive properties of solid insulating materials — Part 3-2: Determination of resistive properties (DC methods) — Surface resistance and surface resistivity*

3 Terms and definitions

No terms and definitions are listed in this document.

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 Preparation of test specimens

4.1 General

Test specimens shall be prepared by compression moulding.

The method applied shall be indicated in the list of properties for every test specimen, using “Q” as the code-letter for compression moulding.

It is essential that all specimens prepared by a particular method are prepared using the same processing conditions given in [Tables 1](#) and [2](#).

4.2 Treatment of the material before moulding

Before compression moulding, the material shall be preplasticized in a two-roll mill, using the conditions specified in [Table 1](#).

4.3 Compression moulding

Unless it constitutes a variable under study, the required number of milled sheets shall be placed cross-layered in the preheated mould and prepare compression-moulded sheets in accordance with ISO 293, using the conditions specified in [Table 2](#).

Table 1 — Conditions for preplasticizing test specimens

Material	Mill-roll surface temperature °C	Milling time min	Roll surface speed m/min	Friction ratio	Roll nip width mm	Roll diameter mm	Roll length mm
All grades	(VST B50) + 90 (±10)	5 ± 1	e.g. 10	1:1,2	e.g. 1	e.g. 150	e.g. 300

Table 2 — Conditions for compression moulding of test specimens

Material	Moulding temperature °C	Average cooling rate °C/min	Demoulding temperature °C	Full pressure MPa	Full-pres- sure time min	Preheating pressure MPa	Preheating time min
All grades	(VST B50) + 100 (±10)	15 ± 3	≤40	7,5 ± 2,5	3,5 ± 1,5	~0,5	~5

The test specimens required for the determination of the properties shall be machined from the compression-moulded sheets in accordance with ISO 2818 or stamped.

5 Conditioning of test specimens

The test specimens shall be conditioned in accordance with ISO 291 for at least 16 h at $23\text{ °C} \pm 2\text{ °C}$ and $50\% \pm 5\%$ relative humidity.

The minimum time between the preparation of a test specimen and the test shall be 16 h, except that for electrical properties it shall be 24 h.

6 Determination of properties

In the determination of properties and the presentation of results, the standards, methods and special conditions listed in [Table 3](#) shall apply. The supplementary instructions and notes given in ISO 10350-1 shall also be taken into consideration.

All tests shall be carried out at $23\text{ °C} \pm 2\text{ °C}$ and $50\% \pm 5\%$ relative humidity, unless otherwise stated in [Table 3](#).

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Table 3 — Properties and test conditions

Property		Symbol	Standard	Specimen type (dimensions in mm)	Specimen preparation ^a	Unit	Test condition and supplementary instructions	
1 Mechanical properties								
1.1	Tensile modulus ^b	E_t	ISO 527-1 ISO 527-2 ISO 527-4	ISO 20753	Q	MPa	Test speed 1 mm/min.	
1.2	Yield stress	σ_y				MPa	Test speed 50 mm/min.	
1.3	Yield strain	ε_y				%	Test speed 50 mm/min.	
1.4	Strain at break	ε_B				%	Test speed 50 mm/min.	
1.5	Stress at 50 % strain	σ_{50}				MPa	Test speed 50 mm/min.	
1.6	Tensile creep modulus	E_{tc1}	ISO 899-1	ISO 20753	Q	MPa	At 1 h	Strain $\leq 0,5$ %
		E_{tc10^3}					At 1 000 h	
1.7	Flexural modulus	E_f	ISO 178	80 × 10 × 4	Q	MPa	Test speed 2 mm/min.	
1.8	Flexural strength	σ_{fM}				MPa		
1.9	Charpy notched impact strength ^b	α_{cA}	ISO 179-1 or ISO 179-2	80 × 10 × 4 Machined V-notch, r = 0,25	Q	kJ/m ²	Edgewise impact, method 1eA. Also record type of failure.	
1.10	Tensile notched impact strength	α_{tI}	ISO 8256	80 × 10 × 4 Machined double V-notch, r = 1	Q	kJ/m ²	Only to be quoted if fracture cannot be obtained with notched Charpy test.	
2 Thermal properties								
2.1	Temperature of deflection under load	$T_f 1,8$	ISO 75-1 ISO 75-2	80 × 10 × 4	Q	°C	1,8 MPa, Use flatwise loading.	
2.2	Vicat softening temperature ^b	VSTB50	ISO 306	10 × 10 × 4	Q	°C	Heating rate 50 °C/h, load 50 N.	
2.3	Flammability	v	IEC 60695-11-10	125 × 13 × 3 (thicker than preferred specimen)	Q	mm/min	Method A — linear burning rate of horizontal specimens.	
		t _f				s	Method B — afterflame and afterglow times of vertical specimens.	
2.4	Oxygen index	—	ISO 4589-2 ISO 4589-3	80 × 10 × 4	Q	%	Use procedure A (top surface ignition).	