
**Plastics — Ethylene-vinyl acetate
(EVAC) moulding and extrusion
materials —**

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

*Plastiques — Matériaux à base de copolymère éthylène-acétate de
vinyle (EVAC) 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).

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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*.

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.

This first edition of ISO 21301-2 cancels and replaces the second edition of ISO 4613-2:1995, which has been technically revised to introduce a new designation system. It also incorporates the Amendment ISO 4613-2:1995/Amd.1:2004. The main changes compared to the previous edition are as follows:

- the normative references has been updated;
- the contents and structures of [Table 2](#) and [Table 3](#) have been revised according to the revised ISO 10350-1.

A list of all parts in the ISO 21301 series can be found on the ISO website.

Plastics — Ethylene-vinyl acetate (EVAC) 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 ethylene/vinyl acetate (EVAC) moulding and extrusion materials. Requirements for handling test material and for conditioning both the test material before moulding and the specimens before testing are given in this document.

This document gives procedures and conditions for the preparation of test specimens and procedures for measuring properties of the materials from which these specimens are made. Properties and test methods which are suitable and necessary to characterize EVAC moulding and extrusion materials are listed in this document.

The properties have been selected from the general test methods in ISO 10350-1. Other test methods in wide use for or of particular significance to these moulding and extrusion materials are also included in this document, as are the designatory properties specified in ISO 21301-1.

The methods of preparation and conditioning, the specimen dimensions and the test procedures specified in this document are used in order to obtain reproducible and comparable test results. Values determined will 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 291, *Plastics — Standard atmospheres for conditioning and testing*

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

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

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

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

ISO 1628-3, *Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 3: Polyethylenes and polypropylenes*

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

ISO 3915, *Plastics — Measurement of resistivity of conductive plastics*

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

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

ISO 8985, *Plastics — Ethylene/vinyl acetate copolymer (EVAC) thermoplastics — Determination of vinyl acetate content*

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

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 11359-2, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 20753, *Plastics — Test specimens*

ISO 21301-1, *Plastics — Ethylene-vinyl acetate (EVAC) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

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*

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

IEC 60243-1, *Electric strength of insulating material — 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 methods*

IEC 60695-11-20, *Fire hazard testing — Part 11-20: Test flames — 500W flame test methods*

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.

It is essential that the specimens are always prepared by the same procedure using the same processing conditions.

The material shall be kept in moisture-proof containers until it is required for use.

Moisture content of filled or reinforced materials shall be expressed as a percentage of the total mass of the compound.

4.2 Treatment of the material before moulding

Before processing, no pretreatment of the material sample is normally necessary.

4.3 Compression moulding

Compression-moulded sheets shall be prepared in accordance with ISO 293, using the conditions specified in [Table 1](#). 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.

A type 1 (frame) mould may be used, but it is necessary to start cooling while simultaneously applying the full pressure. This avoids the melt being pressed out of the frame and avoids sink marks. For thicker sheet (4 mm to 6 mm), a type 2 (positive) mould has been found to work satisfactorily. The preheating time depends on the type of mould and the energy input (steam, electricity). For frame moulds, 5 min is usually sufficient, but for positive moulds, due to the bigger mass, a preheating time of 5 min to 15 min can be necessary, especially if electric heating is used. When using a positive (type 2) mould, a pressure of about 5 MPa to 10 MPa shall be applied to the material.

5 Conditioning of test specimens

Test specimens shall be conditioned in accordance with ISO 291 for at least 16 h at $23\text{ °C} \pm 2\text{ °C}$. There is no requirement for this to be done at a particular relative humidity.

6 Determination of properties

In the determination of properties and the presentation of data, the standards, supplementary instructions and notes given in ISO 10350-1 shall be applied. All tests shall be carried out in the standard atmosphere of $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 10)\%$ relative humidity unless specifically stated otherwise in [Tables 2](#) and [3](#).

[Table 2](#) is compiled from ISO 10350-1, and the properties listed are those which are appropriate to EVAC moulding and extrusion materials. These properties are those considered useful for comparisons of data generated for different thermoplastics.

[Table 3](#) contains those properties, not found specifically in [Table 2](#), which are in wide use or of particular significance in the practical characterization of EVAC moulding and extrusion materials.

Table 1 — Conditions for compression moulding of test specimens

Material	Moulding temperature °C	Average cooling rate °C/min	Demoulding temperature °C	Full pressure MPa	Full-pre-heating time min	Preheating pressure MPa	Preheating time min
≤10 % vinyl acetate	155	15	≤40	20	5 ± 1	Contact	5 to 15
>10 % vinyl acetate	125	15	≤40	10	5 ± 1	Contact	5 to 15

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Table 2 — General properties and test conditions (selected from ISO 10350-1)

Property	Symbol	Standard	Specimen type (dimensions in mm)	Unit	Specimen preparation	Test conditions and supplementary instructions
Rheological properties						
Melt mass-flow rate	MFR	ISO 1133-1	Moulding compound	g/10 min	—	See conditions given in ISO 21301-1
Melt volume-flow rate	MVR			cm ³ /10 min		
Mechanical properties						
Tensile modulus	E_t	ISO 527-1 ISO 527-2	See ISO 20753	MPa	Q	Test speed 1 mm/min
Yield stress	σ_y			%		Test speed 50 mm/min
Yield strain	ε_y					
Nominal strain at break	ε_{tBb}			MPa		Test speed 5 mm/min. Only to be quoted if strain at break is less than 10 %
Stress at break	σ_{Bb}			%		
Strain at break	ε_{Bb}	MPa		At 1 h	Strain < 0,5 %	
Tensile creep modulus	E_{tc1} E_{tc10^3}					
Flexural modulus	E_f	ISO 178	80 × 10 × 4	MPa		Test speed 2 mm/min
Charpy notched impact strength	a_{cA}	ISO 179-1	80 × 10 × 4 V-notch, r = 0,25	kJ/m ²		Edgewise impact Also record type of failure
Tensile – impact strength	a_{tN}	ISO 8256	80 × 10 × 4 Machined double V-notch, r = 1	kJ/m ²		
Thermal properties						
Melting temperature	T_m	ISO 11357-3	Moulding compound	°C	—	Record peak melting temperature. Use 10 °C/min

Table 2 (continued)

Property	Symbol	Standard	Specimen type (dimensions in mm)	Unit	Specimen preparation	Test conditions and supplementary instructions	
Temperature of deflection under load	T _{f0,45}	ISO 75-1	80 × 10 × 4	°C	Q	0,45 MPa and 1,8 MPa. Use flatwise loading.	
	T _{f1,8}	ISO 75-2				Parallel Transverse	Record the secant value over the temperature range 23 °C to 55 °C
Coefficient of linear ther- mal expansion	α _p	ISO 11359-2	Prepared from ISO 20753	K-1		Record one of the classification V-0, V-1, V-2, HB40 or HB75	
	α _n	ISO 11359-2				Record classification 5VA, 5VB, or N	
Burning behaviour	B50/3	IEC 60695-11-10	125 × 13 × 3			Use procedure A (top surface ignition)	
	B50/h	Additional thickness h					
	B500/3	IEC 60659-11-20	≥ 150 × ≥ 150 × 3				
	B500/h	Additional thickness h					
Oxygen index	OI	ISO 4589-2	80 × 10 × 4	%			
Electrical properties							
Relative permittivity	ε _r 100	IEC 60250	≥ 60 × ≥ 60 × 2 or Type A1 (only for ISO 3915) or ≥ 10 × 75 to ≥ 150 × 2 (only for ISO 3915)	—	Q	100 Hz	
	ε _r 1M			—		1 MHz	
Dissipation factor	tan δ100	—		100 Hz		Compensate for electrode edge effects	
	tan δ1M	—		1 MHz			
Volume resistivity	ρ _e	IEC 62631-3-1 or ISO 3915		Ω·m			Value at 1 minute
Surface resistivity	σ _e	IEC 62631-3-2		Ω		Use electrode arrange- ment C – Annular elec- trodes, or electrode arrangement E – Line elec- trodes for small plates.	
Electric strength	E _B 1	IEC 60243-1	≥ 60 × ≥ 60 × 1	kV/mm	Q	Use 20 mm diameter spherical electrodes	
	E _B 2		≥ 60 × ≥ 60 × 2			Immerse in transformer oil in accordance with IEC 60296	
Comparative tracking index	CTI	IEC 60112	≥ 20 × ≥ 20 × 4	—		Use a voltage application rate of 2 kV/s	
						Use solution A	

Table 2 (continued)

Property	Symbol	Standard	Specimen type (dimensions in mm)	Unit	Specimen preparation	Test conditions and supplementary instructions
Other properties						
Water absorption	w_w	ISO 62	$\geq 60 \times \geq 60 \times 1$	%	Q	Saturation value in water at 23 °C
	w_H					Equilibrium value at 23 °C, 50 % RH
Density	ρ	ISO 1183-1	Thickness ≥ 1	kg/m ³	Q	
Q = Compression moulding						