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Plastics — Polystyrene (PS) moulding and extrusion materials —

Part 2:
Preparation of test specimens and determination of properties

Plastiques — Matériaux à base de polystyrène (PS) 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).

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 24022-2 cancels and replaces ISO 1622-2:1995, which has been technically revised.

The main changes compared to the previous edition are as follows:

— the normative references have been updated to the latest version;

— terms and definitions have been added (see Clause 3);

— Table 2 and Table 3 have been updated according to the revised ISO 10350-1.

A list of all parts in the ISO 24022 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 — Polystyrene (PS) 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 PS moulding and extrusion materials. It gives requirements for handling test material and for conditioning both the test material before moulding and the specimens before testing.

This document specifies the procedures and conditions for the preparation of test specimens and procedures for measuring properties of the materials from which these specimens are made. It lists the properties and test methods which are suitable and necessary to characterize PS moulding and extrusion materials.

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 24022-1.

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 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-3, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

ISO 294-4, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 4: Determination of moulding shrinkage*

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

ISO 489, *Plastics — Determination of refractive index*

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 2561, *Plastics — Determination of residual styrene monomer in polystyrene (PS) and impact-resistant polystyrene (PS-I) by gas chromatography*

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

ISO 6603-2, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 2: Instrumented impact testing*

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 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and step height*

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*

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 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 — 50 W horizontal and vertical flame test methods*

IEC 62631-2-1, *Dielectric and resistive properties of solid insulating materials-Part 2-1:Relative permittivity and dissipation factor-Technical frequencies (0,1 Hz to 10 MHz)-AC Methods*

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

In order to obtain reproducible and comparable test results, it is necessary to use the methods of preparation and conditioning, the specimen dimensions and the test procedures specified herein. Values determined are necessarily identical to those obtained using specimens of different dimensions or prepared using different procedures.

It is essential that specimens are always prepared using the same procedure of injection moulding, and under the same processing conditions.

The procedure to be used for each test method is indicated in Table 1.

4.2 Treatment of the material before moulding

Pre-treatment of the material sample is normally not necessary before moulding.

4.3 Injection moulding

Injection-moulded specimens shall be prepared in accordance with ISO 294-1 or ISO 294-3, under the conditions specified in Table 1. It has been found that bar test specimens prepared in accordance with ISO 20753 give better precision than those injection-moulded directly to their final dimensions, and so the use of this geometry is preferable.

An appropriate hold pressure, consistent with the production of blemish-free mouldings, shall be used.

The uniformity of the mouldings shall be checked by weighing. Their masses shall not differ by more than 1 % from each other.

Table 1 — Conditions for injection moulding of test specimens

Material	Melt temperature °C	Mould temperature °C	Average injection velocity mm/s
All grades	220	45	200 ± 20

5 Conditioning of test specimens

After moulding, test specimens shall be conditioned in accordance with ISO 291 for at least 16 h at 23 °C ± 2 °C and (50 ± 10) % 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. Unless specifically stated in Table 2 and Table 3, all tests shall be carried out in the standard atmosphere of 23 °C ± 2 °C and 50 % ± 10 % relative humidity.

Table 2 is compiled from ISO 10350-1, and the properties listed are those which are appropriate to PS 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 PS moulding and extrusion materials.

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

Property		Symbol	Standard	Specimen type mm	Specimen preparation[a]	Unit	Test conditions and supplementary instructions	
1 Rheological properties								
1.1	Melt mass-flow rate	*MFR*	ISO 1133-1	Moulding compound	—	g/10 min	Temperature 200 °C, load 5 kg	
1.2	Melt volume-flow rate	*MVR*				cm^3/10 min		
1.3	Moulding shrinkage	S_{Mp}	ISO 294-4	60 × 60 × 2	M	%	Parallel	
1.4		S_{Mn}					Normal	
2 Mechanical properties								
2.1	Tensile modulus	E_t	ISO 527-1 ISO 527-2	ISO 20753 Type A1	M	MPa	Test speed 1 mm/min.	
2.2	Stress at break	σ_b					Test speed 5 mm/min.	
2.3	Strain at break	ε_b				%		
2.4	Tensile creep modulus	$E_{tc}1$	ISO 899-1			MPa	At 1 h	Strain ≤ 0,5 %
2.5		$E_{tc}10^3$					At 1 000 h	
2.6	Flexural modulus	E_f	ISO 178	80 × 10 × 4		MPa	Test speed 2 mm/min	
2.7	Flexural strength	σ_{fM}						
2.8	Charpy impact strength	α_{cU}	ISO 179-1	80 × 10 × 4		kJ/m^2	Edgewise impact, method 1eU. Also record type of failure	
2.9	Charpy notched impact strength	α_{cA}		80 × 10 × 4 Machined V-notch, r = 0,25			Edgewise impact, method 1eA. Also record type of failure.	
2.10	Tensile notched impact strength	α_{tN}	ISO 8256	80 × 10 × 4 Machined double V-notch, r = 1		kJ/m^2	Only to be quoted if fracture cannot be obtained with notched Charpy test.	
3 Thermal properties								
3.1	Glass transition temperature	T_g	ISO 11357-2	Moulding compound	—	°C	Record the method used for determination of T_g. Use 10 K/min heating rate.	
3.2	Temperature of deflection under load	T_f 1,8	ISO 75-1 ISO 75-2	80 × 10 × 4 flatwise	M	°C	1,8 MPa	Maximum surface stress
3.3		T_f 0,45					0,45 MPa	
3.4	Vicat softening temperature	*VST B50*	ISO 306	≥ 10 × 10 × 4		°C	Heating rate 50 K/h, Load 50 N	
3.5	Coefficient of linear thermal expansion	α_p	ISO 11359-2	Prepared from ISO 20753 Type A1		°C^{-1}	Parallel	Record the secant value over the temperature range 23 °C to 55 °C.
3.6		α_n				°C^{-1}	Transverse	
3.7	Flammability-Burning behaviour	B50/3	IEC 60695-11–10	125 × 13 × 3		—	Record one of the classifications V-0, V-1, V-2, HB, HB40 or HB75.	
3.8		B50/*h*		Thickness h greater than 3 mm		—		
3.9	Ignitability-Oxygen index	OI	ISO 4589-2	80 × 10 × 4		%	Use procedure A (top surface ignition).	

[a] M = Injection moulding.

[b] The properties are generally affected by the relative humidity. Therefore, they shall be measured in a standard atmosphere of 23 °C ± 2 °C and 50 % ± 10 % relative humidity.

Table 2 *(continued)*

Property		Symbol	Standard	Specimen type mm	Specimen preparation[a]	Unit	Test conditions and supplementary instructions	
4 Electrical properties[b]								
4.1	Relative permittivity	ε_r 100	IEC 62631-2–1	≥ 60 × ≥ 60 × 1 or ≥ 60 × ≥ 60 × 2	M	—	100 Hz	Compensate for electrode edge effects.
4.2		ε_r 1M					1 MHz	
4.3	Dissipation factor	tan δ 100				—	100 Hz	
4.4		tan δ 1M					1 MHz	
4.5	Volume resistivity	ρ_e	IEC 62631-3–1			Ω·m	Voltage 100 V	Measure value at 1 min.
4.6	Surface resistivity	σ_e	IEC 62631-3–2			Ω		Use contacting line electrodes 1 mm to 2 mm wide, 50 mm long and 5 mm apart.
4.7	Electric strength	E_B 1	IEC 60243-1	≥ 60 × ≥ 60 × 1		kV/mm	Use 20 mm diameter spherical electrodes. Immerse in transformer oil in accordance with IEC 60296. Use a voltage application rate of 2 kV/s.	
4.8		E_B 2		≥ 60 × ≥ 60 × 2				
4.9	Comparative tracking index	CTI	IEC 60112	≥ 20 × ≥ 20 × 4		—	Use solution A.	

[a] M = Injection moulding.

[b] The properties are generally affected by the relative humidity. Therefore, they shall be measured in a standard atmosphere of 23 °C ± 2 °C and 50 % ± 10 % relative humidity.