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Plastics — Polyoxymethylene (POM) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

Plastiques — Matériaux à base de polyoxyméthylène (POM) 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 on 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 the following URL: 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 29988-2 cancels and replaces ISO 9988-2:2006, which has been technically revised.

A list of all parts in the ISO 29988 series can be found on the ISO website.

Plastics — Polyoxymethylene (POM) 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 polyoxymethlene (POM) moulding and extrusion materials.

Requirements for handling test materials and for conditioning both the test materials before moulding and the specimens before testing are specified. Procedures and conditions for the preparation of test specimens and procedures for measuring properties of the materials from which these specimens are made are given.

Properties and test methods which are suitable and necessary to characterize POM moulding and extrusion materials are listed. The properties have been selected from the general test methods. 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: melt flow rate and tensile modulus.

In order to obtain reproducible and comparable test results, it is intended to use the methods of preparation and conditioning, the specimen dimensions and the test procedures specified in this document. 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 75-2, *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 properties — Part 2: Instrumented impact test*

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 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 pyknometer method and titration method*

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*

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 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:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 Preparation of test specimens

4.1 General

Specimens shall be prepared by injection moulding. It is essential that they are always prepared by the same procedure, using the same processing conditions. The standard conditions are given in Table 1.

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

4.2 Treatment of the material before moulding

No pretreatment of the material sample is necessary before processing.

NOTE POM moulding materials adsorb moisture on the surface of the particles, which can lead to surface defects in moulded specimens. To ensure mouldings are free of surface defects, the material can be dried for 4 h at 80 °C in a circulating air environment.

4.3 Injection moulding

Specimens shall be prepared in accordance with ISO 294-1, ISO 294-3 or ISO 294-4, using the conditions specified in Table 1.

Table 1 — Conditions for injection moulding of test specimens

Material	Melt temperature °C	Mould temperature °C	Average injection velocity mm/s
Homopolymer, MFR ≤7	215	90	140 ± 100
Homopolymer, MFR >7	215	90	300 ± 100
Homopolymer, impact-modified, MFR ≤7	210	60	140 ± 100
Copolymer, MFR >4	205	90	200 ± 100
Copolymer, impact-modified	205	80	200 ± 100
Copolymer, MFR ≤4	205	90	140 ± 100
Copolymer, high modulus, MFR ≤4	210	100	140 ± 100

5 Conditioning of test specimens

Test specimens shall be conditioned in accordance with ISO 291 for at least 16 h at (23 ± 2) °C and (50 ± 10) % relative humidity.

NOTE If test specimen conditioning and testing is in the subtropical atmosphere of 27 °C/65 % relative humidity found in ISO 291, then this is to be noted in the test report and the results cannot be compared to those obtained at the standard specified conditioning temperature and 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 at a standard temperature of (23 ± 2) °C and (50 ± 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 polyoxymethylene (POM) 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 ISO 10350-1, which are in wide use or of particular significance in the practical characterization of polyoxymethylene (POM) moulding and extrusion materials. These properties may be based on specimens which are not listed in ISO 10350-1. Refer to Clause 5 if using a subtropical conditioning and testing atmosphere.

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

Property		Symbol	Standard	Specimen type (dimensions in mm)	Unit	Test condition and supplementary instructions	
1 Rheological properties							
1.1	Melt mass-flow rate	MFR	ISO 1133-1	Moulding compound	g/ 10 min	Temperature 190 °C, load 2,16 kg.	
1.2	Melt volume-flow rate	MVR			cm^3/ 10 min	Temperature 190 °C, load 2,16 kg.	
2 Mechanical properties							
2.1	Tensile modulus	E_t	ISO 527-2	ISO 20753, type A	MPa	Test speed 1 mm/min.	
2.2	Yield stress	σ_y				Failure with yielding. Test speed 50 mm/min.	
2.3	Yield strain	ε_y			%		
2.4	Nominal strain at break	ε_{tB}					
2.5	Stress at 50 % strain	σ_{50}			MPa	Failure without yielding. $\varepsilon_B \leq 10$ %: test speed 5 mm/min. $\varepsilon_B > 10$ %: test speed 50 mm/min.	
2.6	Stress at break	σ_B					
2.7	Strain at break	ε_B			%		
2.8	Tensile creep modulus	$E_{tc}1$	ISO 899-1		MPa	At 1 h	Strain ≤0,5 %.
2.9		$E_{tc}10^3$				At 1 000 h	
2.10	Flexural modulus	E_f	ISO 178	80 × 10 × 4[a]	MPa	Test speed 2 mm/min.	
2.11	Charpy impact strength	α_c	ISO 179-1 or ISO 179-2	80 × 10 × 4[a]	kJ/m^2	Edgewise impact, method 1eU. Also record type of failure.	
2.12	Charpy notched impact strength	α_{cA}		80 × 10 × 4[a] V-notch, r = 0,25		Edgewise impact, method 1eA. Also record type of failure.	
3 Thermal properties							
3.1	Melting temperature	T_m	ISO 11357-3	Moulding compound	°C	Record peak melting temperature. Use 10 °C/min heating/cooling rate.	
3.2	Temperature of deflection under load	T_f 1,8	ISO 75-2	80 × 10 × 4[a]	°C	Maximum surface stress (MPa)	1,8 Use flatwise loading.
3.3		T_f 0,45					0,45
3.4	Coefficient of linear thermal expansion	α_p	ISO 11359-2	See ISO 20753, prepared from type A1 or B1	K^{-1}	Parallel	Record the secant value over the temperature range 23 °C to 55 °C.
3.5		α_n				Transverse	

Table 2 *(continued)*

Property		Symbol	Standard	Specimen type (dimensions in mm)	Unit	Test condition and supplementary instructions	
4 Electrical properties[c]							
4.1	Relative permittivity	ε_r 100	IEC 60250	≥ 60 × ≥ 60 × 2	—	100 Hz	Compensate for electrode edge effects.
4.2		ε_r 1M				1 MHz	
4.3	Dissipation factor	tanδ 100			—	100 Hz	Compensate for electrode edge effects.
4.4		tanδ 1M				1 MHz	
4.5	Volume resistivity	ρ_e	IEC 62631-3-1		Ω·m	Voltage 500 V	Measure value at 1 min.
4.6	Surface resistivity	σ_e	IEC 62631-3-2		Ω	Voltage 500 V	
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	Comparative tracking index	CTI-A	IEC 60112	≥ 20× ≥ 20 × 4	—	Use solution A.	
5 Other properties							
5.1	Water absorption	ω_w	ISO 62	60 × 60 × 1	%	Saturation value in water at 23 °C.	
5.2		ω_H				Equilibrium value at 23 °C, 50 % RH.	
5.3	Density	ρ	ISO 1183-1	10 × 10 × 4[a]	kg/m^3		
[a] This can be taken from the central part of ISO 20753 type A1 or B1.							

Table 3 — Additional properties and test conditions of particular utility to polyoxymethylene moulding and extrusion materials

Property		Symbol	Standard	Specimen type (dimensions in mm)	Unit	Test condition and supplementary instructions
Mechanical properties						
	Izod notched impact strength	α_{IA}	ISO 180	80 × 10 × 4[a]	kJ/m^2	Method A
[a] This can be taken from the central part of ISO 20753 type A1 or B1.						

Bibliography

[1] ISO 180, *Plastics — Determination of Izod impact strength*

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