INTERNATIONAL STANDARD

ISO 9988-2

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 9988-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This third edition cancels and replaces the second edition (ISO 9988-2:1999), which has been technically revised to bring Table 2 and the normative references into continuity with ISO 10350-1:1998. Copolymer, high modulus, MFR $\leqslant$ 4 has been added to Table 1.

ISO 9988 consists of the following parts, under the general title *Plastics — Polyoxymethylene (POM) moulding and extrusion materials*:

— *Part 1: Designation system and basis for specifications*

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

Plastics — Polyoxymethylene (POM) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

This part of ISO 9988 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of polyoxymethylene 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.

Procedures and conditions are described for the preparation of test specimens, and procedures are given for measuring properties of the materials from which these specimens are made. Properties and test methods which are suitable and necessary to characterize polyoxymethylene moulding and extrusion materials are listed.

The properties have been selected from the general test methods in ISO 10350-1:1998. Other test methods in wide use for, or of particular significance to, these moulding and extrusion materials are also included in this part of ISO 9988 as designatory properties specified in ISO 9988-1: melt flow rate and tensile modulus.

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

2 Conformance

In Clause 3, the year of the publication of each normative reference has been specifically stated. In order to be able to claim conformity with this part of ISO 9988, it is essential that the user use only those editions given, and not earlier or more recent editions.

3 Normative references

The following referenced documents are indispensable for the application 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 62:1999, *Plastics — Determination of water absorption*

ISO 75-2:2004, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178:2001, *Plastics — Determination of flexural properties*

ISO 179-1:2000, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 180:2000, *Plastics — Determination of Izod impact strength*

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*

ISO 294-1:1996, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-3:2002, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

ISO 294-4:2001, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 4: Determination of moulding shrinkage*

ISO 527-2:1993, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 899-1:2003, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*

ISO 1133:2005, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

ISO 1183-1:2004, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 3167:2002, *Plastics — Multipurpose test specimens*

ISO 10350-1:1998, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 11357-3:1999/Amd1:2005, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization — Amendment 1*

ISO 11359-2:1999, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60243-1:1998, *Electrical strength of insulating materials — Test methods — Part 1: Tests at power frequencies*

IEC 60250:1969, *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 60296:2003, *Fluids for electrotechnical applications — Unused mineral insulating oils for transformers and switchgear*

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 below.

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 normally necessary before processing.

NOTE POM moulding materials adsorb moisture on the surface of the particles, which may lead to surface defects in moulded specimens. To assure mouldings are free of surface defects, the material may be dried for a minimum of 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 ± 5) % relative humidity.

NOTE If test specimen conditioning and testing is in the sub-tropical atmosphere of 27 °C/65 % relative humidity found in ISO 291, then this is to be noted in the test report and the results may not 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 10350-1:1998 shall be applied. All tests shall be carried out in the standard atmosphere of (23 ± 2) °C and (50 ± 5) % relative humidity unless specifically stated otherwise in Tables 2 and 3.

Table 2 is compiled from ISO 10350-1:1998 and the properties listed are those which are appropriate to polyoxymethylene 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 10350-1:1998, which are in wide use or of particular significance in the practical characterization of polyoxymethylene moulding and extrusion materials. These properties may be based on specimens which are not listed in ISO 10350-1:1998. Refer to Clause 5 if using a subtropical conditioning and testing atmosphere.

Table 2 — General properties and test conditions (selected from ISO 10350-1:1998)

Property	Unit	Standard	Specimen type (dimensions in mm)	Test conditions and supplementary instructions	
Rheological properties					
Melt mass-flow rate	g/10 min	ISO 1133	Moulding compound	Temperature 190 °C, load 2,16 kg	
Melt volume-flow rate	cm^3/10 min				
Mechanical properties					
Tensile modulus	MPa	ISO 527-2	ISO 3167, type A	Test speed 1 mm/min	
Yield stress				Test speed 50 mm/min	
Yield strain	%				
Nominal strain at break					
Stress at break	MPa			Test speed 5 mm/min. Only to be quoted if strain at break is < 10 %.	
Strain at break	%				
Tensile creep modulus	MPa	ISO 899-1	ISO 3167, type A	At 1 h	Strain ⩽ 0,5 %
				At 1 000 h	
Flexural modulus		ISO 178	80 × 10 × 4	Test speed 2 mm/min	
Charpy impact strength	kJ/m^2	ISO 179-1	80 × 10 × 4	Method 1e (edgewise impact)	
Charpy notched impact strength			80 × 10 × 4 V-notch r = 0,25 (notch A)		
Thermal properties					
Melting temperature	°C	ISO 11357-3	Moulding compound	Use 10 °C/min.	
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4 flatwise	Method A (1,8 MPa) and method B (0,45 MPa)	
Coefficient of linear thermal expansion	$°C^{-1}$	ISO 11359-2	Prepared from ISO 3167	Parallel	Quote the secant value over the temperature range 23 °C to 55 °C
				Normal	
Electrical properties					
Relative permittivity	—	IEC 60250	60 × 60 × 2	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)	
Dissipation factor	—	IEC 60250	60 × 60 × 2	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)	
Volume resistivity	Ω·m	IEC 60093	60 × 60 × 2	Voltage 500 V	
Surface resistivity	Ω	IEC 60093	60 × 60 × 2	Voltage 500 V	
Electric strength	kV/mm	IEC 60243-1	60 × 60 × 2	Use 20 mm diameter spherical electrode configuration. Immerse in IEC 60296 transformer oil. Voltage rate 2 kV/s.	
Comparative tracking index	—	IEC 60112	⩾ 15 × ⩾ 15 × 4	Use solution A.	
Other properties					
Water absorption	%	ISO 62	60 × 60 × 2	Saturation value in water at 23 °C	
Density	kg/m^3	ISO 1183-1	10 × 10 × 4		
Moulding shrinkage	%	ISO 294-4	60 × 60 × 2	Report shrinkage perpendicular and parallel to flow, post-moulding shrinkage and total shrinkage.	

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

Property	Unit	Standard	Specimen type (dimensions in mm)	Test conditions and supplementary instructions
Mechanical properties				
Izod impact strength, notched	kJ/m^2	ISO 180	80 × 10 × 4	Method A

NOTE At the next periodic review, consideration may be given to eliminating notched Izod. There has been sufficient time to establish notched Charpy impact for comparable properties since this was determined to be the preferred notched bar test.