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Plastics — Sulfone polymer moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

Plastiques — Matériaux pour moulage et extrusion à base de polymères sulfone —
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 25137-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

ISO 25137 consists of the following parts, under the general title *Plastics — Sulfone polymer moulding and extrusion materials*:

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

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

Plastics — Sulfone polymer moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

1.1 This part of ISO 25137 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of sulfone polymer 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 here.

1.2 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 sulfone polymer moulding and extrusion materials are listed.

1.3 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 part of ISO 25137, as are the designatory properties specified in Part 1.

1.4 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 specified herein. Values determined will not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

2 Normative references

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 180, *Plastics — Determination of Izod impact strength*

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

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

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

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

ISO 3167, *Plastics — Multipurpose test specimens*

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 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*

ISO 15512, *Plastics — Determination of water content*

ISO 25137-1, *Plastics — Sulfone polymer moulding and extrusion materials — Part 1: Designation system and basis for specifications*

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

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 — 50 W horizontal and vertical flame test methods*

3 Preparation of test specimens

3.1 General

It is essential that specimens always be prepared by the same procedure, using the same processing conditions. The procedure to be used for each test method is indicated in Table 2.

3.2 Treatment of the material before moulding

Before moulding, the material shall be dried to a moisture level of no more than 0,05 % as determined using ISO 15512.

3.3 Injection moulding

Injection-moulded specimens shall be prepared in accordance with ISO 294-1, using the conditions specified in Table 1.

Table 1 — Conditions for injection moulding of test specimens

Material	Melt temperature °C	Mould temperature °C	Injection velocity mm/s
PSU	345 to 390	100 to 160	200 ± 100
PESU	345 to 390	130 to 180	
PPSU	360 to 390	140 to 180	

4 Conditioning of test specimens

Test specimens for melt rheology and thermal analysis (i.e. determination of glass transition temperature, T_g) shall be dried and stored in a desiccator at (23 ± 2) °C before testing. The recommended drying conditions for these specimens are 2 h at 160 °C. The target moisture level is < 300 ppm. Test specimens for temperature of deflection under load shall be annealed as per Table 2 before conditioning for at least 24 h at (23 ± 2) °C and (50 ± 10) % relative humidity. Test specimens for other properties shall be conditioned for at least 24 h at (23 ± 2) °C and (50 ± 10) % relative humidity.

5 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 one of the standard atmospheres in ISO 291 unless specifically stated otherwise in Table 2. A test atmosphere of (23 ± 2) °C and (50 ± 10) % relative humidity shall be used in cases of dispute.

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

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

Property	Unit	Test method	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Rheological properties					
Melt mass-flow rate	g/10 min	ISO 1133	Moulding compound	—	PSU: 343 °C, load 2,16 kg PESU: 380 °C, load 2,16 kg PPSU: 365 °C, load 5,00 kg Alternative conditions: 360 °C, load 10,00 kg
Melt volume-flow rate	cm^3/10 min				
Mechanical properties					
Tensile modulus	MPa	ISO 527-2	ISO 3167	Injection moulding	Test speed: 50 mm/min for unreinforced materials 5,0 mm/min for reinforced materials
Yield stress					
Yield strain	%				
Strain at break					
Tensile creep modulus	MPa	ISO 899-1			At 1 h / At 1 000 h: Strain ⩽ 0,5 %
Flexural modulus	MPa	ISO 178	80 × 10 × 4		Test speed 2 mm/min
Flexural strength					
Charpy unnotched impact strength	kJ/m^2	ISO 179-1 or ISO 179-2	80 × 10 × 4/1eU		Edgewise impact. Also record type of failure.
Charpy notched impact strength			80 × 10 × 4/1eA		
Tensile notched impact strength		ISO 8256	80 × 10 × 4 double V-notch, $r = 1$		Only to be quoted if fracture cannot be obtained with notched Charpy impact test.
Thermal properties					
Glass transition temperature	°C	ISO 11357-2	Moulding compound	—	Use a scan rate of 10 °C/min. Record midpoint temperature.
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4	Injection moulding followed by annealing (see next column)	Heating rate 120 °C/h Flexural stress 1,8 MPa Edgewise impact Anneal specimens for 4 h at 140 °C or for 1 h at one of the following temperatures: PSU: 170 °C; PESU and PPSU: 200 °C. Before testing, condition specimens at (23 ± 2) °C and (50 ± 10) % RH for at least 24 h.

Table 2 (*continued*)

Property	Unit	Test method	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions	
Vicat softening temperature	°C	ISO 306	⩾ 10 × 10 × 4	Injection moulding	Heating rate 50 °C/h Load 50 N	
Burning behaviour	—	IEC 60695-11-10	125 × 13 × 3		Record one of classifications V-0, V-1, V-2, HB40, HB75.	
Oxygen index	%	ISO 4589	80 × 10 × 4		Use procedure A (top surface ignition).	
Electrical properties						
Relative permittivity	—	IEC 60250	⩾ 60 × ⩾ 60 × 2	Injection moulding	Frequency 100 Hz and 1 MHz; compensate for electrode edge effects.	
Dissipation factor	—					
Volume resistivity	Ω·m	IEC 60093	⩾ 60 × ⩾ 60 × 2		Voltage 100 V	1-minute value.
Surface resistivity	Ω					Use contacting line electrodes 1 mm to 2 mm wide, 50 mm long and 5 mm apart.
Electric strength	kV/mm	IEC 60243-1	⩾ 60 × ⩾ 60 × 1 or ⩾ 60 × ⩾ 60 × 2		Use 25 mm/75 mm coaxial-cylinder electrodes. Immerse in transformer oil conforming to IEC 60296. Use a 20 s step-by-step test.	
Comparative tracking index	—	IEC 60112	⩾ 60 × ⩾ 60 × 2		Use solution A.	
Other properties						
Water absorption	%	ISO 62	60 × 60 × 2	Injection moulding	Measure saturation value in water at 23 °C and equilibrium value at 23 °C and 50 % relative humidity.	
Density	kg/m^3 (g/cm^3)	ISO 1183-1	10 × 10 × 4		Specimen to be taken from moulded product.	