
**Plastics — Poly(phenylene sulfide) (PPS)
moulding and extrusion materials —**

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

Plastiques — Matériaux pour moulage et extrusion en poly(phénylène sulfide) (PPS) —

Partie 2: Préparation des éprouvettes et détermination des propriétés



Reference number
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Foreword

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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 28078-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

ISO 28078 consists of the following parts, under the general title *Plastics — Poly(phenylene sulfide) (PPS) moulding and extrusion materials*:

- *Part 1: Designation system and basis for specifications*
- *Part 2: Preparation of test specimens and determination of properties*

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Plastics — Poly(phenylene sulfide) (PPS) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

This part of ISO 28078 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of poly(phenylene sulfide) 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 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 poly(phenylene sulfide) moulding and extrusion materials are listed.

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 28078, as are the designatory properties specified in ISO 28078-2 (melt mass-flow rate or melt viscosity, density 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 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

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

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 pycnometer method and titration method*

ISO 3451-1, *Plastics — Determination of ash — Part 1: General methods*

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 11443, *Plastics — Determination of the fluidity of plastics using capillary and slit-die rheometers*

ISO 15512, *Plastics — Determination of water content*

ISO 20753, *Plastics — Test specimens*

ISO 28078-1, *Plastics — Poly(phenylene sulfide) (PPS) 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 are always prepared by the same procedure (injection moulding), using the same processing conditions.

3.2 Treatment of material before moulding

Before processing, the moisture content of the material sample shall not exceed 0,05 % by mass. If the moisture level exceeds this limit, the sample shall be dried in accordance with the manufacturer's instructions until the moisture content no longer exceeds the limit. The moisture content of the material is expressed as the percentage, by mass, of the total mass of the thermoplastic and fillers.

To ensure that the moisture content remains low, it is recommended that the sample material in the feed hopper of the injection-moulding machine be blanketed with a suitable gas (e.g. dry air, nitrogen or argon). Better results may be obtained by using a dehumidifying hopper-drier.

3.3 Injection moulding

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

Melt temperature °C	Mould temperature °C	Average injection velocity mm/s	Hold time s	Total cycle time s
320	140	350 ± 150	20 ± 10	60

4 Conditioning of test specimens for physical, thermal and electrical properties

Test specimens shall be conditioned in accordance with ISO 291 for at least 4 h at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ 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 the standard atmosphere of $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ 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 PPS moulding 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 PPS moulding materials.

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

Property	Unit	Standard	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	—	See ISO 28078-1	
Melt volume-flow rate	cm ³ /10 min					
Melt viscosity	Pa·s	ISO 11443	Moulding compound	—	See ISO 28078-1	
Mechanical properties						
Tensile modulus	MPa	ISO 527-2	ISO 20753 type A1	Injection moulding	Test speed 1 mm/min	
Yield stress	MPa				Failure with yielding: Test speed 50 mm/min	
Yield strain	%					
Nominal strain at break	%				Failure without yielding: If strain at break ≤ 10 %, test speed 5 mm/min If strain at break > 10 %, test speed 50 mm/min	
Stress at break	MPa					
Strain at break	%					
Flexural modulus	MPa	ISO 178	ISO 20753 type B	Injection moulding	Test speed 2 mm/min	
Flexural strength	MPa					
Charpy notched impact strength	kJ/m ²	ISO 179-1	ISO 20753 type B V-notch <i>r</i> = 0,25	Injection moulding	Method 1eA (edgewise impact)	
Thermal properties						
Temperature of deflection under load	°C	ISO 75-2	ISO 20753 type B	Injection moulding	1,8 MPa (flatwise impact)	
Coefficient of linear thermal expansion	°C ⁻¹	ISO 11359-2	ISO 20753 ^a	Injection moulding	Parallel	Record the secant value over the temperature range 23 °C to 55 °C
					Transverse	
Flammability	mm/min	IEC 60695-11-10	125 × 13 × 3 (see ISO 10350-1)	Injection moulding	Method A: linear burning rate of horizontal specimens	
	s				Method B: a) after-flame time and b) after-glow time of vertical specimens	
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	Injection moulding	Voltage 500 V	
Surface resistivity	Ω					
Electrical strength	kV/mm	IEC 60243-1	≥ 60 × ≥ 60 × 1	Injection moulding	Use 25 mm/25 mm coaxial-cylinder electrode configuration. Immerse in transformer oil in accordance with IEC 60296. Use short-time (rapid-rise) test.	
			≥ 60 × ≥ 60 × 2			
Comparative tracking index	—	IEC 60112	≥ 20 × ≥ 20 × 4	Injection moulding	Use solution A	

Table 2 (continued)

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Other properties					
Water absorption	%	ISO 62	Thickness ≥ 1	Injection moulding	Saturation value in water at $(23 \pm 2) ^\circ\text{C}$
Density	kg/m ³	ISO 1183-1	Prepared from centre of type A1	Injection moulding	—
^a It is recommended that the specimen be taken from the type A1 (multipurpose) test specimen specified in ISO 20753.					

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

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Melting temperature	°C	ISO 11357-3	Moulding compound	—	Record the peak temperature Use 20 °C/min
Ash	%	ISO 3451-1	Moulding compound	—	Only for filled and reinforced grades (600 \pm 25) °C or (750 \pm 50) °C ^a
^a The recommended ashing temperature is (600 \pm 25 °C). This is because when a test sample containing fillers, e.g. minerals, is ashed at (750 \pm 50 °C), chemical reactions can occur between the filler and the PPS polymer, leading to high ash values. When (600 \pm 25) °C is used, the recommended ashing time is at least 3 h.					

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