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

Part 2: Preparation of test specimen and determination of properties

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

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 20558-2 cancel and replaces ISO 28078-2:2009, which has been technically revised.

A list of all parts in the ISO 20558 series can be found on the ISO website.

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

Part 2: Preparation of test specimen 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 poly(phenylene sulfide) (PPS) 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 document as are the designatory properties specified in ISO 20558-1 (melt mass-flow rate or melt viscosity, density 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 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 1133-1, *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 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 20753, *Plastics — Test specimens*

ISO 20558-1, *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 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

It is essential that specimens are always prepared by the same procedure (injection moulding), using the same processing conditions.

4.2 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.

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

5 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 ± 2) °C and (50 ± 5) % 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. 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, 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 1133-1	Moulding compound	—	See ISO 20558-1
Melt volume-flow rate	cm^3/10 min				
Melt viscosity	Pa·s	ISO 11443	Moulding compound	—	See ISO 20558-1
a It is recommended that the specimen be taken from the type A1 (multipurpose) test specimen specified in ISO 20753.					

Table 2 *(continued)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
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	%				
Stress at break	MPa				Failure without yielding: If strain at break ≤ 10 %, test speed 5 mm/min If strain at break > 10 %, test speed 50 mm/min
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/m²	ISO 179-1	ISO 20753 type B V-notch *r* = 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 / Transverse: Record the secant value over the temperature range 23 °C to 55 °C
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 ≥ 60 × ≥ 60 × 2	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.
Comparative tracking index	—	IEC 60112	≥ 20 × ≥ 20 × 4	Injection moulding	Use solution A

[a] It is recommended that the specimen be taken from the type A1 (multipurpose) test specimen specified in ISO 20753.

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 ± 2) °C
Density	kg/m³	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 ± 25) °C or (750 ± 50) °C[a]

[a] The recommended ashing temperature is (600 ± 25) °C. This is because when a test sample containing fillers, e.g. minerals, is ashed at (750 ± 50) °C, chemical reactions can occur between the filler and the PPS polymer, leading to high ash values. When (600 ± 25) °C is used, the recommended ashing time is at least 3 h.