
**Plastics — Poly(phenylene ether) (PPE)
moulding and extrusion materials —**

Part 2:

**Preparation of test specimens and
determination of properties**

*Plastiques — Matériaux à base de poly(phénylène éther) (PPE) pour
moulage et extrusion —*

Partie 2: Préparation des éprouvettes et détermination des propriétés



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Foreword

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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 15103-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 15103-2:2000), which has been technically revised.

ISO 15103 consists of the following parts, under the general title *Plastics — Poly(phenylene ether) (PPE) moulding and extrusion materials*:

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

Plastics — Poly(phenylene ether) (PPE) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

This part of ISO 15103 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of poly(phenylene ether) 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.

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 ether) 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 15103, as are the designatory properties specified in ISO 15103-1.

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 180, *Plastics — Determination of Izod impact strength*

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 15103-2:2007(E)

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

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

ISO 1183-3, *Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pycnometer method*

ISO 3167, *Plastics — Multipurpose test specimens*

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

ISO 8256 *Plastics — Determination of tensile-impact strength*

ISO 10350-1:1998, *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 11359-2:1999, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 15103-1, *Plastics — Poly(phenylene ether) (PPE) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 15512, *Plastics — Determination of water content*

IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulation 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.

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

Material	Temperature of deflection under load (see ISO 15103-1)	Filler content % by mass	Melt volume-flow rate		Melt temperature °C	Mould temperature °C
			Conditions	Value cm ³ /10 min		
PPE	A210	0	—	—	340	120
PPE+PS	A080	0	—	—	220	50
	A090	0	250 °C, 10 kg	> 30	220	60
				≤ 30	240	
		> 0 but ≤ 50	—	—	260	
	A100 A110	0	250 °C, 10 kg	> 20	240	70
				≤ 20	260	
		> 0 but ≤ 50	300 °C, 5 kg	> 20	260	
				≤ 20	280	
	A120 A130	0	250 °C, 10 kg	> 5	280	80
				≤ 5	290	
		> 0 but ≤ 50	300 °C, 5 kg	> 10	280	
				≤ 10	290	
	A140 A150	0	250 °C, 10 kg	> 3	300	100
				≤ 3	310	
		> 0 but ≤ 50	300 °C, 5 kg	> 4	290	
				≤ 4	300	
A160	≤ 50	—	—	310	120	
A170	≤ 50	—	—	320	120	
A180 A190 A200	≤ 50	—	—	340	120	
A210	0	—	—	340	120	
PPE+PA	—	≤ 50	280 °C, 5 kg	> 30	280	100
		≤ 30		300		
PPE+PP	—	≤ 50	250 °C, 10 kg	> 5	250	60
		≤ 5		270		
PPE+PPS	—	≤ 70	300 °C, 10 kg	> 30	300	100
		≤ 30		320		
PPE+other	B180	≤ 30	—	—	280	80
		> 30 but ≤ 50			300	100
	B190	0	—	—	290	90
		> 0 but ≤ 50			300	100
	B200	0	—	—	310	120
		> 0 but ≤ 50			320	120
B210	≤ 50	—	—	320	120	
PPE+PS+other	A200	≤ 50	—	—	320	120

Other injection-moulding conditions shall be as follows:

For PPE, PPE+PS, PPE+PS+other
 Average injection velocity: 200 mm/s ± 100 mm/s
 Hold pressure: 70 MPa ± 30 MPa
 Hold-pressure time: 20 s ± 5 s
 Total cycle time: ≤ 50 s

For PPE+PA, PPE+PP, PPE+PPS, PPE+other
 Average injection velocity: 200 mm/s ± 100 mm/s
 Hold pressure: 50 MPa ± 30 MPa
 Hold pressure time: 20 s ± 5 s
 Total cycle time: ≤ 50 s

4 Conditioning of test specimens

4.1 General

Test specimens of all materials which are not modified with polyamides shall be conditioned for at least 24 h at $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 10)\%$ relative humidity. Properties of polyamide-modified material shall be determined on specimens in the dry-as-moulded state or on specimens in the moist state. The state of the specimens shall be stated in the test report.

4.2 Dry-as-moulded state

Specimens shall be moulded from dry granules (see 3.2 and 3.3). Specimens are considered to be in the dry-as-moulded state when they have been placed immediately after moulding in a moisture-proof container at $23\text{ °C} \pm 2\text{ °C}$ and stored at this temperature for at least 48 h.

To keep moisture absorption at a low level, dry-as-moulded specimens shall be tested in as short a time as possible (maximum 15 min) after removal from the moisture-proof container.

Annealing specimens prior to testing is not allowed.

5 Determination of properties

In the determination of properties and the presentation of data, the standards, supplementary instructions and notes given in ISO 10350-1:1998 shall be applied. All tests shall be carried out in the standard atmosphere of $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 10)\%$ 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 PPE 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 PPE moulding materials.

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	250 °C/10 kg for PPE+PS (unfilled) and PPE+PP
Melt volume-flow rate	cm ³ /10 min			300 °C/5 kg for PPE+PS (filled) 280 °C/5 kg for PPE+PA 300 °C/10 kg for PPE+PPS
Mechanical properties				
Tensile modulus	MPa	ISO 527-2	See ISO 3167	Test speed 1 mm/min
Yield stress	MPa			Test speed 50 mm/min
Yield strain	%			
Nominal strain at break	%			
Stress at 50 % strain	MPa			
Stress at break	MPa			
Strain at break	%			
Flexural modulus	MPa	ISO 178	80 × 10 × 4	Test speed 2 mm/min
Flexural strength	MPa			
Charpy impact strength	kJ/m ²	ISO 179-1	80 × 10 × 4	Method 1eU (edgewise impact)
Charpy notched impact strength	kJ/m ²		80 × 10 × 4 V-notch r = 0,25	Method 1eA (edgewise impact)
Thermal properties				
Melting temperature, T_{pm}	°C	ISO 11357-3	Moulding compound	Record peak melting temperature. Use 10 °C/min rise and fall.
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4	1,8 MPa and 0,45 MPa
Coefficient of linear thermal expansion	°C ⁻¹	ISO 11359-2	Prepared from ISO 3167	Record the secant value over the temperature range 23 °C to 55 °C.
Flammability	mm/min	IEC 60695-11-10	125 × 13 × 1,5 or 3	Method A — linear burning rate of horizontal specimens
	s			Method B (vertical) a) afterflame time, b) afterglow time
Electrical properties				
Relative permittivity	—	IEC 60250	≥ 80 × ≥ 80 × 1	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)
Dissipation factor	—			
Volume resistivity	Ω·m	IEC 60093		Voltage 500 V
Surface resistivity	Ω			
Electrical strength	kV/mm	IEC 60243-1	≥ 80 × ≥ 80 × 1	Use 20 mm/75 mm coaxial-cylinder electrode configuration. Immerse in IEC 60296 transformer oil. Use short-time (rapid-rise) test.
			≥ 80 × ≥ 80 × 3	
Comparative tracking index	—	IEC 60112	≥ 15 × ≥ 15 × 4	Use solution A
Other properties				
Water absorption	%	ISO 62	50 × 50 × 3 or Ø 50 × 3 disc	24 h immersion in water at 23 °C
Density		Any part of ISO 1183	Use part of centre of multipurpose test specimen	

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

Property	Unit	Standard	Specimen type (dimensions in mm)	Test conditions and supplementary instructions
Mechanical properties				
Izod impact strength ^a	kJ/m ²	ISO 180	≥ 80 × ≥ 80 × 4 V-notch, <i>r</i> = 0,25	Methods 1U and 1A
Other properties				
Ash	%	ISO 3451-1	Moulding compound	Only for filled grades
Moisture content	%	ISO 15512	Moulding compound	
Flammability ^b	mm/min	IEC 60695-11-10	125 × 13 × <i>d</i> where <i>d</i> < 13	Method A
	s			Method B
^a This method is listed temporarily. ^b This property is used for designation purposes when measured using a 1,5-mm-thick specimen (see Table 2).				

