
**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

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 3.

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 part of ISO 15103 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

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*

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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 10350:1993. 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 part 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 normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15103. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15103 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 62:1999, *Plastics — Determination of water absorption.*

ISO 75-1:1993, *Plastics — Determination of temperature of deflection under load — Part 1: General test method.*

ISO 75-2:1993, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite.*

ISO 178:1993, *Plastics — Determination of flexural properties.*

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

ISO 180:—²⁾, *Plastics — Determination of Izod impact strength.*

1) To be published. (Revision of ISO 179:1993)

2) To be published. (Revision of ISO 180:1993)

ISO 15103-2:2000(E)

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 527-1:1993, *Plastics — Determination of tensile properties — Part 1: General principles.*

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

ISO 1133:1997, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 3146:2000, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods.*

ISO 3167:1993, *Plastics — Multipurpose test specimens.*

ISO 3451-1:1997, *Plastics — Determination of ash — Part 1: General methods.*

ISO 8256:1990, *Plastics — Determination of tensile-impact strength.*

ISO 10350:1993³⁾, *Plastics — Acquisition and presentation of comparable single-point data.*

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

ISO 15103-1:2000, *Plastics — Poly(phenylene ether) (PPE) moulding and extrusion materials — Part 1: Designation system and basis for specifications.*

ISO 15512:1999, *Plastics — Determination of water content.*

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

IEC 60112:1979, *Method for determining comparative and the proof tracking indices of solid insulation materials under moist conditions.*

IEC 60243-1:1998, *Electrical strength of solid 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 60296:1982, *Specification for unused mineral oils for transformers and switchgear.*

IEC 60695-11-10:1999, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods.*

3) ISO 10350:1993 is the normative reference, even though it has been replaced by ISO 10350-1:1998.

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 part 1)	Filler content % by mass	Melt temperature °C	Mould temperature °C
PPE	A210	0	340	120
PPE+PS	A090	0	260	60
	A100 A110	≤ 50	270	60
	A120 A130	≤ 50	280	80
	A140 A150	≤ 50	290	90
	A160	≤ 50	310	120
	A170	≤ 50	320	120
	A190 A180 A200	≤ 50	340	120
	A210	0	340	120
PPE+PA	B170 B180	≤ 50	290	90
	B190 B200 B210	≤ 50	300	100
	B180	≤ 30	280	80
		> 30 but ≤ 50	300	100
PPE+other	B190	0	290	90
		≤ 50	300	100
	B200	0	310	120
		≤ 50	320	120
	B210	≤ 50	320	120
PPE+PS+other	A200	≤ 50	320	120

Other injection-moulding conditions shall be as follows (for all materials):
Average injection velocity: 200 mm/s ± 100 mm/s
Hold pressure: 70 MPa ± 10 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 in accordance with ISO 291 for at least 24 h at $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 5)\%$ 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 (DAM) state

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

To keep moisture absorption at a low level, DAM 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 10350:1993 shall be applied. All tests shall be carried out in the standard atmosphere of $23\text{ °C} \pm 2\text{ °C}$ and $(50 \pm 5)\%$ relative humidity unless specifically stated otherwise in Tables 2 and 3.

Table 2 is compiled from ISO 10350:1993, 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 10350:1993)

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 non-filled PS-modified PPE (PPE-2) 300 °C/5 kg for filled PS-modified PPE (PPE-2) 280 °C/5 kg for PA-modified PPE (PPE-3)
Melt volume-flow rate	cm ³ /10 min			
Mechanical properties				
Tensile modulus	MPa	ISO 527-1 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	%			Test speed 5 mm/min. Only to be quoted if the strain at break, when tested at 50 mm/min, is < 10 %.
Stress at 50 % strain	MPa			
Stress at break	MPa			
Strain at break	%			ISO 178
Flexural modulus	MPa			
Flexural strength	MPa	ISO 179-1	80 × 10 × 4 V-notch, r = 0,25	Method 1eU (edgewise impact)
Charpy impact strength	kJ/m ²			Method 1eA (edgewise impact)
Charpy notched impact strength	kJ/m ²			
Thermal properties				
Melting temperature	°C	ISO 3146	Moulding compound	Method C (DSC or DTA). Use 10 °C/min.
Temperature of deflection under load	°C	ISO 75-1 ISO 75-2	80 × 10 × 4 flatwise	0,45 MPa and 1,8 MPa
Coefficient of linear thermal expansion	°C ⁻¹	ISO 11359-2	Prepared from ISO 3167	Longitudinal. Record the secant value over the temperature range 23 °C to 55 °C.
Flammability	mm/min	IEC 60695-11-10	125 × 13 × 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	≥ 80 × ≥ 80 × 1	Voltage 100 V
Surface resistivity	Ω			
Electrical strength	kV/mm	IEC 60243-1	≥ 80 × ≥ 80 × 1	Use 25 mm/75 mm coaxial-cylinder electrode configuration. Immerse in IEC 60926 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 ∅ 50 × 3 disc	24 h immersion in water at 23 °C
Density	kg/m ³	ISO 1183	Use part of centre of multipurpose test specimen	