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

**Part 2:
Preparation of test specimen 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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 20557-2 cancels and replaces ISO 15103-2:2007, which has been technically revised.

A list of all parts in the ISO 20557 series can be found on the ISO website.

Plastics — Poly(phenylene ether) (PPE) 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 ether) (PPE) 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 ether) 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 20557-1.

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 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 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 20557-2:2018(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 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 15512, *Plastics — Determination of water content*

ISO 20557-1, *Plastics — Poly(phenylene ether) (PPE) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 20753, *Plastics — Test Specimens*

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 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.

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

Material	Temperature of deflection under load (see ISO 20557-1)	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	
	A090	> 0 but ≤ 50	—	—	260	70
				—	260	
	A100 A110	0	250 °C, 10 kg	> 20	240	70
				≤ 20	260	
	A100 A110	> 0 but ≤ 50	300 °C, 5 kg	> 20	260	80
				≤ 20	280	
	A120 A130	0	250 °C, 10 kg	> 5	280	80
				≤ 5	290	
	A120 A130	> 0 but ≤ 50	300 °C, 5 kg	> 10	280	100
				≤ 10	290	
	A140 A150	0	250 °C, 10 kg	> 3	300	100
				≤ 3	310	
	A140 A150	> 0 but ≤ 50	300 °C, 5 kg	> 4	290	120
≤ 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	

Other injection-moulding conditions shall be as follows:

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

Table 1 (continued)

Material	Temperature of deflection under load (see ISO 20557-1)	Filler content % by mass	Melt volume-flow rate		Melt temperature °C	Mould temperature °C
			Conditions	Value cm ³ /10 min		
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

Other injection-moulding conditions shall be as follows:

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

5 Conditioning of test specimens

5.1 General

Test specimens of all materials which are not modified with polyamides shall be conditioned for at least 24 h at 23 °C ± 2 °C and 50 % ± 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.

5.2 Dry-as-moulded state

Specimens shall be moulded from dry granules (see 4.2 and 4.3). 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 °C ± 2 °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.

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 °C ± 2 °C and 50 % ± 10 % 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 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)**

Property	Unit	Standard	Specimen type (dimensions in mm)	Test conditions and supplementary instructions
Rheological properties				
Melt mass-flow rate	g/10 min	ISO 1133-1	Moulding compound	250 °C/10 kg for PPE+PS (un- filled) and PPE+PP 300 °C/5 kg for PPE+PS (filled) 280 °C/5 kg for PPE+PA 300 °C/10 kg for PPE+PPS
Melt volume-flow rate	cm ³ /10 min			
Mechanical properties				
Tensile modulus	MPa	ISO 527-2	See ISO 20753 Type A1	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	%	Test speed 5 mm/min. Only to be quoted if the strain at break, when tested at 50 mm/min, is < 10 %.		
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 tempera- ture. 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 20753 Type A1	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			