INTERNATIONAL STANDARD

ISO 7792-2

Second edition
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Plastics — Thermoplastic polyester (TP) moulding and extrusion materials —

Part 2:
Preparation of test specimens and determination of properties

Plastiques — Polyesters thermoplastiques (TP) pour moulage et extrusion —
Partie 2: Préparation des éprouvettes et détermination des propriétés

Reference number
ISO 7792-2:1997(E)

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.

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.

International Standard ISO 7792-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 7792-2:1988) and includes the following changes:

— The scope has been expanded to include all thermoplastic polyester (TP) homopolymers and copolymers.

— The text has been brought into accordance with the standard SC 9 frame text.

— PCT and PEN have been added, and moulding conditions have been listed in a new table.

— The table of standard properties and test conditions has been revised in accordance with ISO 10350.

ISO 7792 consists of the following parts, under the general title *Plastics — Thermoplastic polyester (TP) 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 — Thermoplastic polyester (TP) moulding and extrusion materials —

Part 2:
Preparation of test specimens and determination of properties

1 Scope

This part of ISO 7792 specifies the methods of preparation of test specimens and the standard test methods to be used in determining the properties of thermoplastic polyester 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 for the preparation of test specimens in a specified state 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 thermoplastic polyester moulding and extrusion materials are listed.

The properties have been selected from the general test methods in ISO 10350. 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 7792, as are the designatory properties specified in part 1 (viscosity number and tensile modulus of elasticity).

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 standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7792. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7792 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 62:1980, *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 179:1993, *Plastics — Determination of Charpy impact strength.*

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 specimens.*

ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*

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 899-1:1993, *Plastics — Determination of creep behaviour — Part 1: Tensile creep.*

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

ISO 1210:—[1)], *Plastics — Determination of the burning behaviour of horizontal and vertical specimens in contact with a small-flame ignition source.*

ISO 1628-5:—[2)], *Plastics — Determination of viscosity number and limiting viscosity number — Part 5: Thermoplastic polyester (TP) homopolymers and copolymers.*

ISO 2818:1994, *Plastics — Preparation of test specimens by machining.*

ISO 3146:1985, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers.*

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

ISO 3451-2:—[3)], *Plastics — Determination of ash — Part 2: Poly(alkylene terephthalate) plastics.*

ISO 4589-1:1996, *Plastics — Determination of burning behaviour by oxygen index — Part 1: Guidance.*

ISO 4589-2:1996, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test.*

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

ISO 10350:1993, *Plastics — Acquisition and presentation of comparable single-point data.*

IEC 93:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials.*

IEC 112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.*

IEC 243-1:1988, *Methods of test for electric strength of solid insulating materials — Part 1: Tests at power frequencies.*

IEC 250:1969, *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 296:1982, *Specification for unused mineral insulating oils for transformers and switchgear.*

IEC 1006:1991, *Methods of test for the determination of the glass transition temperature of electrical insulating materials.*

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1) To be published. (Revision of ISO 1210:1992)

2) To be published. (Revision of ISO 1628-5:1986)

3) To be published. (Revision of ISO 3451-2:1984)

3 Preparation of test specimens

The test specimens shall be prepared by injection moulding.

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

The material shall be kept in moisture-proof containers until it is required for use.

Moisture content of filled or reinforced materials shall be expressed as a percentage of the total mass of the compound.

3.1 Treatment of the material before moulding

Before processing, the moisture content of the material sample shall not exceed 0,02 % (m/m). In the case of filled materials, this limit refers to the total mass of thermoplastic and filler.

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 any suitable gas (dried air, nitrogen or argon, for example). Better results may be obtained using a dehumidifier hopper dryer.

3.2 Injection moulding

Injection-moulded 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	Melt temperature °C	Mould temperature °C	Average injection velocity mm/s	Hold pressure time s	Total cycle time s
PBT, unfilled, semi-crystalline	260	80	200 ± 100	20 ± 5	40 ± 5
PBT, unfilled, semi-crystalline, impact-modified and/or flame-retarded	250	80	200 ± 100	20 ± 5	40 ± 5
PBT, filled, semi-crystalline	260	80	200 ± 100	20 ± 5	40 ± 5
PBT, filled, semi-crystalline, impact-modified and/or flame-retarded	250	80	200 ± 100	20 ± 5	40 ± 5
PET, unfilled, amorphous	285	20	200 ± 100	20 ± 5	40 ± 5
PET, unfilled, semi-crystalline	275	135	200 ± 100	20 ± 5	40 ± 5
PET, filled, semi-crystalline	285	135	200 ± 100	20 ± 5	40 ± 5
PET, filled, semi-crystalline, nucleated	285	110	200 ± 100	20 ± 5	40 ± 5
PET, filled, semi-crystalline, flame-retarded	275	135	200 ± 100	20 ± 5	40 ± 5
PET, filled, semi-crystalline, flame-retarded, nucleated	275	110	200 ± 100	20 ± 5	40 ± 5
PCT, unfilled, amorphous	300	20	200 ± 100	20 ± 5	40 ± 5
PCT, unfilled, semi-crystalline	300	120	200 ± 100	20 ± 5	40 ± 5
PCT, filled, semi-crystalline	300	120	200 ± 100	20 ± 5	40 ± 5
PEN, unfilled, amorphous	300	20	200 ± 100	20 ± 5	40 ± 5

4 Conditioning of test specimens

Test specimens for the determination of mechanical properties, electrical properties and density shall be conditioned in accordance with ISO 291 for at least 16 h at 23 °C ± 2 °C and (50 ± 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 shall be applied. All tests shall be carried out in the standard atmosphere of 23 °C ± 2 °C and (50 ± 5) % relative humidity unless specifically stated otherwise in tables 2 and 3.

Table 2 is complied from ISO 10350, and the properties listed are those which are appropriate to thermoplastic polyester moulding and extrusion materials. These properties are those considered useful for comparisons of data generated for different thermoplastics.

Table 3 contains those properties, test conditions and/or test specimens, not found specifically in table 2, which are in wide use or of particular significance in the practical characterization of thermoplastic polyester moulding and extrusion materials. Comparisons of different materials using these properties may well be restricted to those thermoplastics in the same generic families.

Table 2 — Standard properties and test conditions (selected from ISO 10350)

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[1)]	Test conditions and supplementary instructions
Mechanical properties					
Tensile modulus	MPa	ISO 527-1, ISO 527-2	See ISO 3167	M	Test speed 1 mm/min
Yield stress	MPa				Test speed 50 mm/min
Yield strain	%				Test speed 50 mm/min
Nominal strain at break	%				Test speed 50 mm/min
Stress at 50 % strain	MPa				Test speed 50 mm/min
Stress at break	MPa				Test speed 5 mm/min. Only to be quoted if stress at 50 % strain cannot be obtained
Strain at break	%				
Tensile creep modulus	MPa	ISO 899-1	See ISO 3167	M	At 1 h / At 1 000 h: Strain ⩽ 0,5 %
Flexural modulus	MPa	ISO 178	See ISO 3167	M	Test speed 2 mm/min
Flexural strength	MPa				
Charpy impact strength	kJ/m^2	ISO 179	$80 \times 10 \times 4$	M	Method 1eU (edgewise impact)
Charpy notched impact strength	kJ/m^2		$80 \times 10 \times 4$ V-notch, $r = 0{,}25$	M	Method 1eA (edgewise impact)

Table 2 — Standard properties and test conditions *(concluded)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[1)]	Test conditions and supplementary instructions
Thermal properties					
Melting temperature	°C	ISO 3146	Moulding compound	—	Method C (DSC or DTA). Use 10 °C/min
Glass transition temperature	°C	IEC 1006	Moulding compound	—	Method A (DSC or DTA). Use 10 °C/min
Temperature of deflection under load	°C	ISO 75-1, ISO 75-2,	80 × 10 × 4 flatwise[2)] or 110 × 10 × 4 edgewise	M	0,45 MPa and 1,8 MPa
Vicat softening temperature	°C	ISO 306	10 × 10 × 4	M	Heating rate 50 °C/h, load 50 N
Coefficient of linear thermal expansion	$°C^{-1}$	TMA (see ISO 10350)	Prepared from ISO 3167	M	Parallel / Normal: Quote the secant value over the temperature range 23 °C to 55 °C
Flammability	mm/min s	ISO 1210	125 × 13 × 13 Additional specimen of thickness < 3 mm (see ISO 10350)	M	Method A — linear burning rate of horizontal specimens Method B — a) afterflame time Method B — b) afterglow time
Ignitability	%	ISO 4589-1 ISO 4589-2	80 × 10 × 4	M	Procedure A — top surface ignition
Electrical properties					
Relative permittivity Dissipation factor	— —	IEC 250	⩾ 80 × ⩾ 80 × 1	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)
Volume resistivity Surface resistivity	Ω·m Ω	IEC 93	⩾ 80 × ⩾ 80 × 1	M	Voltage 500 V
Electric strength	kV/mm	IEC 243-1	⩾ 80 × ⩾ 80 × 1 ⩾ 80 × ⩾ 80 × 3	M M	Use 25 mm/75 mm coaxial-cylinder electrode configuration. Immerse in IEC 296 transformer oil. Use short time (rapid rise) test
Comparative tracking index	—	IEC 112	⩾ 15 × ⩾ 15 × 4	M	Use solution A
Other properties					
Water absorption	%	ISO 62	Thickness ⩽ 1	M	Saturation value in water at 23 °C Saturation value at 23° C and 50 % R.H.
Density	kg/m^3	ISO 1183	10 × 10 × 4	M	

1) M = injection moulding

2) The 80 × 10 × 4 flatwise specimen shall be used for referee testing.

Table 3 — Specialized properties and test conditions

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[1)]	Test conditions and supplementary instructions
Properties/conditions/specimens of special utility to TP moulding and extrusion materials					
Ash	%	ISO 3451-2	Moulding compound	—	Only on filled grades
Viscosity number	ml/g	ISO 1628-5	Moulding compound	—	Use 50/50 phenol/1,2-dichlorobenzene for PET and *m*-cresol for PBT
Relative permittivity	—	IEC 250	⩾ 80 × ⩾ 80 × 3	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)
Dissipation factor	—	IEC 250	⩾ 80 × ⩾ 80 × 3	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)
Volume resistivity	Ω·m	IEC 93	⩾ 80 × ⩾ 80 × 3	M	Voltage 500 V
Surface resistivity	Ω	IEC 93	⩾ 80 × ⩾ 80 × 3	M	Voltage 500 V

1) M = injection moulding