BS EN ISO 7792-2:2012

BSI Standards Publication

Plastics — Thermoplastic polyester (TP) moulding and extrusion materials

Part 2: Preparation of test specimens and determination of properties

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National foreword

This British Standard is the UK implementation of EN ISO 7792-2:2012. It supersedes BS EN ISO 7792-2:2004, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/82, Thermoplastic materials.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2012.

ISBN 978 0 580 65080 2

ICS 83.080.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2012.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 7792-2

December 2012

ICS 83.080.20

Supersedes EN ISO 7792-2:2004

English Version

Plastics - Thermoplastic polyester (TP) moulding and extrusion materials - Part 2: Preparation of test specimens and determination of properties (ISO 7792-2:2012)

Plastiques - Polyesters thermoplastiques (TP) pour moulage et extrusion - Partie 2: Préparation des éprouvettes et détermination des propriétés (ISO 7792-2:2012)

Kunststoffe - Thermoplastische Polyester (TP)-Formmassen - Teil 2: Herstellung von Probekörpern und Bestimmung von Eigenschaften (ISO 7792-2:2012)

This European Standard was approved by CEN on 24 November 2012.

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Ref. No. EN ISO 7792-2:2012: E

Foreword

This document (EN ISO 7792-2:2012) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 “Plastics” the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2013, and conflicting national standards shall be withdrawn at the latest by June 2013.

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Endorsement notice

The text of ISO 7792-2:2012 has been approved by CEN as a EN ISO 7792-2:2012 without any modification.

Contents

Page

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 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.

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

This third edition cancels and replaces the second edition (ISO 7792-2:1997), which has been technically revised.

ISO 7792 consists of the following parts, under the general title *Plastics — Thermoplastic polyesters*:

— *Part 1: Designation system and basis for specifications*

— *Part 2: Preparation of test specimens and determination of properties*

INTERNATIONAL STANDARD **ISO 7792-2:2012(E)**

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 10350-1. 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 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 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 1133-2, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 2: Method for materials sensitive to time-temperature history and/or moisture*

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

ISO 1628-5, *Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 5: Thermoplastic polyester (TP) homopolymers and copolymers*

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 3451-2, *Plastics — Determination of ash — Part 2: Poly(alkylene terephthalate) materials*

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

ISO 10350-1, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and glass transition step height*

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*

IEC 60093, *Solid electrical insulating materials — Method of test for volume resistivity and surface resistivity*

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

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.

3.2 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.

3.3 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	Mould temperature	Average injection velocity	Hold pressure time	Total cycle time
	°C	°C	mm/s	s	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, 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
PBN, unfilled, semi-crystalline	270	80	200 ± 100	20 ± 5	40 ± 5
PBN, filled, semi-crystalline	270	80	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 ± 10) % 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 10350-1 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 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 10350-1)

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Mechanical properties					
Tensile modulus	MPa	ISO 527-2	See ISO 3167	M	Test speed 1 mm/min
Yield stress	MPa				Test speed 50 mm/min[b]
Yield strain	%				
Nominal strain at break	%				
Stress at 50% strain	MPa				Test speed 50 mm/min[c]
Stress at break	MPa				Test speed: see footnote c
Strain at break	%				Test speed: see footnote c
Charpy impact strength	kJ/m^2	ISO 179-1	80 × 10 × 4	M	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					
Glass transition temperature	°C	ISO 11357-2	Moulding compound	—	Heating rate 10 °C/min
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4 flatwise	M	0,45 MPa and 1,8 MPa
Flammability		IEC 60695-11-10	125 × 13 × 1,5 Additional specimen of thickness 0,75 mm and 3 mm	M	Record one of the classifications V-0,V-1,V-2 HB40 or HB75
Other properties					
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
Water absorption	%	ISO 62	Thickness ≥ 1	M	Saturation value in water at 23 °C Saturation value at 23° C and 50 % RH
Density	kg/m^3	ISO 1183-1 ISO 1183-2 ISO 1183-3	For injection-moulded specimens, use part of the centre of the multipurpose test bar.	M	

[a] M = injection moulding

[b] If rupture occurs at > 50 % nominal strain, record either the measured nominal strain at break or ' > 50'.

[c] If strain at break > 10 % but no yield point below 50 % at 50 mm/min, record stress and strain at break at 50 mm/min. If rupture occurs at > 50 % strain at 50 mm/min, record stress at 50 % strain and the measured strain at break or ' > 50'. If rupture occurs without yielding and strain at break ≤ 10 % when tested at 50 mm/min, use a test speed of 5 mm/min and record the stress and strain at break.

Table 3 — Specialized properties and test conditions

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions	
Properties/conditions/specimens of special utility to TP moulding and extrusion materials						
MFR / MVR	g/10 min / cm^3/10 min	ISO 1133-2	Moulding compound	Drying[b]	PET (un)filled Moisture < 0,02 % Test temperature 270 °C Load 1,2 / 2,16 / 5 / 10 kg MFR/MVR value preferably between 10 and 40.	
				Drying[c]	High viscosity PET Moisture < 0,01 % Test temperature 280 °C Load 1,2 / 2,16 / 5 kg MFR/MVR value preferably between 10 and 40.	
				Drying[d]	PBT (un)filled Moisture < 0,02 % Test temperature 235 °C / 250 °C / 265 °C Load 1,2 / 2,16 / 5 / 10 / 21,6 kg MFR/MVR value preferably between 10 and 40.	
Melting temperature	°C	ISO 11357-3	Moulding compound	—	Record peak melting temperature using 10 °C/min or 20 °C/min for PET and PBT compounds and blends.	
Oxygen index	%	ISO 4589-2	80 × 10 × 4	M	Procedure A — top surface ignition	
Coefficient of linear thermal expansion	$°C^{-1}$	ISO 11359-2	Prepared from ISO 3167	M	Parallel Normal	Quote the secant value over the temperature range 23 °C to 55 °C
Relative permittivity Dissipation factor	— —	IEC 60250	≥ 60 × ≥ 60 × 1 ≥ 60 × ≥ 60 × 2	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)	
Volume resistivity Surface resistivity	Ω·m Ω	IEC 60093	≥ 60 × ≥ 60 × 1 ≥ 60 × ≥ 60 × 2	M	Voltage 500 V	
Electric strength	kV/mm	IEC 60243-1	≥ 60 × ≥ 60 × 1 ≥ 60 × ≥ 60 × 2	M	Use 25 mm/75 mm coaxial-cylinder electrode configuration. Immerse in IEC 60296 transformer oil. Use short time (rapid rise) test.	
Comparative tracking index	—	IEC 60112	≥ 20 × ≥ 20 × 4	M	Use solution A.	

[a] M = injection moulding

[b] Drying: vacuum oven with N_2-flow, ≤ 16h, 120 °C, < 2 MPa (200 mbar); vacuum oven: ≤ 16h, 130 °C, ≤ 200 Pa (2 mbar); hot air/dehumidifying oven: ≤ 5h, 130 °C. Other drying conditions may be used.

[c] Drying: vacuum oven, N_2-flow; ≤ 16h, 130 °C, < 2 MPa (200 mbar); vacuum oven: ≤ 16h, 130 °C, ≤ 200 Pa (2 mbar); hot air/dehumidifying oven: ≤ 5h, 130 °C. Other drying conditions may be used.

[d] Drying: vacuum oven, N_2-flow: ≤ 16h, 105 °C, < 2 MPa (200 mbar); vacuum oven: ≤ 16h, 115 °C, ≤ 200 Pa (2 mbar); hot air/dehumidifying oven: ≤ 5h, 120 °C. Other drying conditions may be used.

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