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Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion —

Part 2:
Preparation of test specimens and determination of properties

Plastiques — Élastomères thermoplastiques à base de polyester/ester et polyéther/ester, pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

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 14910-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

ISO 14910 consists of the following parts, under the general title *Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion*:

— *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/ester and polyether/ester elastomers for moulding and extrusion —

Part 2:
Preparation of test specimens and determination of properties

1 Scope

This part of ISO 14910 specifies the methods of preparation of test specimens and the standard test methods to be used in determining the properties of thermoplastic polyester/ester and polyether/ester 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/ester and polyether/ester 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 14910, as are the designatory properties specified in part 1 (hardness, melting temperature and tensile/flexural modulus of elasticity).

In order to obtain reproducible and comparable test results, it is necessary to use the methods of 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 14910. 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 14910 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 34-1:1994, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces.*

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 868:1985, *Plastics and ebonite — Determination of identation hardness by means of a durometer (Shore hardness).*

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

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

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

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 3451-2:1984)

3 Preparation of test specimens

The 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 sample shall not exceed 0,05 % (*m*/*m*).

To ensure that the moisture content remains low, it is recommended that the 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

Melting temperature °C	Shore D hardness	Specimen thickness mm	Mould temperature °C	Melt temperature °C	Average injection velocity mm/s
⩽ 160	—	2	20	30 °C above melting temperature	200 ± 100
> 160	⩽ 50	2	40	30 °C above melting temperature	200 ± 100
> 160	> 50	2	50	30 °C above melting temperature	200 ± 100
—	—	4	20	30 °C above melting temperature	200 ± 100

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 compiled from ISO 10350, and the properties listed are those which are appropriate to thermoplastic polyester/ester and polyether/ester 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/ester and polyether/ester 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
Rheological properties					
Melt mass-flow rate Melt volume-flow rate	g/10 min cm^3/10 min	ISO 1133	Moulding compound	—	Temperature — [2], load 2,16 kg
Mechanical properties					
Flexural modulus	MPa	ISO 178	80 × 10 × 4	M	Test speed 2 mm/min
Charpy impact strength	kJ/m^2	ISO 179	80 × 10 × 4	M	Method 1eU (edgewise impact)
Charpy notched impact strength	kJ/m^2	ISO 179	80 × 10 × 4 V-notch, r = 0,25	M	Method 1eA (edgewise impact)
Tensile notched impact strength	kJ/m^2	ISO 8256	80 × 10 × 4 double V-notch r = 1	M	Only to be quoted if fracture cannot be obtained with notched Charpy test
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 [3] 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 × 3 Additional specimen of thickness < 3 mm	M	Method A — linear burning rate of horizontal specimens Method B — a) afterflame time b) afterglow time
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 100 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	50 × 50 × 3 or ∅ 50 × 3 disc Thickness ⩽ 1	M M M	24 h immersion in water at 23 °C 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) 190 °C when melting temperature ⩽ 175 °C;
220 °C when melting temperature > 175 °C but ⩽ 210 °C;
240 °C when melting temperature > 210 °C and for all blow-moulding materials.

3) 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
Other properties					
Tensile modulus	MPa	ISO 527-1, ISO 527-2	1BA (see ISO 527-2)	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
Tensile creep modulus	MPa	ISO 899-1	1BA (see ISO 527-2)		At 1 h / At 1 000 h: Strain ⩽ 0,5 %
Tear strength	kN/m	ISO 34-1 method B, procedure (a)	Angle test piece, 2 mm thick	M	Test speed 500 mm/min
Hardness	—	ISO 868	⩾ 80 × ⩾ 80 × ⩾ 6	M	Specimens may be stacked to obtain minimum thickness
Ash	%	ISO 3451-2	Moulding compound	—	Only on filled and/or reinforced grades

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