INTERNATIONAL STANDARD

ISO 7391-2

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Plastics — Polycarbonate (PC) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

Plastiques — Polycarbonate (PC) pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

Reference number
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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 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.

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.

ISO 7391-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This third edition cancels and replaces the second edition (ISO 7391-2:1996), which has been technically revised.

ISO 7391 consists of the following parts, under the general title *Plastics — Polycarbonate (PC) moulding and extrusion materials*:

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

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

Plastics — Polycarbonate (PC) moulding and extrusion materials —

Part 2:
Preparation of test specimens and determination of properties

1 Scope

This part of ISO 7391 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of polycarbonate 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 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 polycarbonate 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 7391, 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 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 Conformance

In Clause 3, the year of publication of each normative reference has been specifically stated. In order to be able to claim conformity with this part of ISO 7391, it is essential that the user use only those editions given, and not earlier or more recent editions.

3 Normative references

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

ISO 75-2:2004, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178:2001, *Plastics — Determination of flexural properties*

ISO 179-1:2000, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 180:2000, *Plastics — Determination of Izod impact strength*

ISO 291:2005, *Plastics — Standard atmospheres for conditioning and testing*

ISO 293:2004, *Plastics — Compression moulding of test specimens of thermoplastic materials*

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 306:2004, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

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

ISO 899-1:2003, *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 1183-1:2004, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 1628-4:1999, *Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 4: Polycarbonate (PC) moulding and extrusion materials*

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

ISO 3167:2002, *Plastics — Multipurpose test specimens*

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

ISO 7391-1, *Plastics — Polycarbonate (PC) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 10350-1:1998, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials*

ISO 11357-2:1999, *Plastics — Differential scanning colorimetry (DSC) — Part 2: Determination of glass transition temperature*

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

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

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60243-1:1998, *Electrical strength of 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 60296:2003, *Fluids for electrotechnical applications — Unused mineral insulating oils for transformers and switchgear*

IEC 60695-11-10:2003, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods*

4 Preparation of test specimens

4.1 General

It is essential that specimens are always prepared by the same procedure (either injection moulding or compression moulding), using the same processing conditions.

The procedure to be used for each test method is indicated in Tables 3 and 4 (M = injection moulding, Q = compression moulding).

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.

4.2 Treatment of the material before moulding

Before processing, the material sample shall be dried for (5 ± 1) h at (120 ± 3) °C. The moisture content shall not exceed 0,02 %.

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 dried air or nitrogen at a temperature of (110 ± 10) °C. Better results may be obtained using a dehumidifier hopper drier.

4.3 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 °C	Mould temperature °C	Average injection velocity mm/s
Non-reinforced grades:			
MVR > 14,2 cm^3/10 min	280	80	200 ± 100
9,5 cm^3/10 min < MVR ⩽ 14,2 cm^3/10 min	290	80	200 ± 100
4,7 cm^3/10 min < MVR ⩽ 9,5 cm^3/10 min	300	80	200 ± 100
MVR ⩽ 4,7 cm^3/10 min	310	90	200 ± 100
Glass-fibre-reinforced grades	300	110	200 ± 100

4.4 Compression moulding

Compression-moulded sheets shall be prepared in accordance with ISO 293, using the conditions specified in Table 2.

Table 2 — Conditions for compression moulding of test specimens

Material	Moulding temperature °C	Full pressure MPa	Full-pressure time min
All grades	300	5	2

After moulding, cool the specimens for 4 min by putting a water-cooled board between the core and the removable bottom plate at a (moulding) pressure of 1 MPa.

The test specimens required for the determination of the properties shall be machined from the compression-moulded sheets in accordance with ISO 2818 or stamped.

5 Conditioning of test specimens

Test specimens for the determination of electrical properties shall be conditioned in accordance with ISO 291 for at least 24 h at (23 ± 2) °C and (50 ± 10) % relative humidity.

Test specimens for the determination of mechanical properties shall be conditioned in accordance with ISO 291 for at least 4 h at (23 ± 2) °C and (50 ± 10) % relative humidity.

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 ± 2) °C and (50 ± 5) % relative humidity unless specifically stated otherwise in Tables 3 and 4.

Table 3 is compiled from ISO 10350-1, and the properties listed are those which are appropriate to polycarbonate moulding and extrusion materials. These properties are those considered useful for comparisons of data generated for different thermoplastics.

Table 4 contains those properties, not found specifically in Table 3, which are in wide use or of particular significance in the practical characterization of polycarbonate moulding and extrusion materials.

Table 3 — General 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
Rheological properties					
Melt volume-flow rate (MVR)	cm^3/10 min	ISO 1133	Moulding compound	—	Temperature 300 °C, load 1,2 kg
Mechanical properties					
Tensile modulus	MPa	ISO 527-2	Injection-moulded type A test specimen as defined in ISO 3167	M	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				Test speed 5 mm/min. Only to be quoted if strain at break is ⩽ 10 %.
Strain at break	%				
Tensile creep modulus	MPa	ISO 899-1			At 1 h and 1 000 h, strain in each case ⩽ 0,5 %
Flexural modulus	MPa	ISO 178	80 × 10 × 4		Test speed 2 mm/min
Flexural strength	MPa				
Charpy unnotched impact strength	kJ/m^2	ISO 179-1eU	80 × 10 × 4		e = edgewise impact U = unnotched

Table 3 (*continued*)

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Thermal properties					
Glass transition temperature	°C	ISO 11357-2	Moulding compound	—	Scan rate 10 °C/min
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4	M	Flexural stress 1,8 MPa and 0,45 MPa, flatwise impact
Vicat softening temperature	°C	ISO 306	⩾ 10 × 10 × 4		Heating rate 50 °C/h, load 50 N
Coefficient of linear thermal expansion	$°C^{-1}$	ISO 11359-2	10 × 10 × 4		Calculate value over range 23°C to 55°C, parallel and transverse to injection-moulding flow direction
Burning behaviour	Class	IEC 60695-11-10	125 × 13 × 1,5 (nominal thickness) or thicker		Use method B, indicating the class from the sequence V-2, V-1, V-0
Oxygen index	%	ISO 4589-2	80 × 10 × 4		Use procedure A (top surface ignition)
Electrical properties					
Relative permittivity	—	IEC 60250	⩾ 60 × ⩾ 60 × 2	M	Frequency 100 Hz and 1 MHz, compensate for electrode edge effects
Dissipation factor	—				
Volume resistivity	Ω·m	IEC 60093			Voltage 500 V
Surface resistivity	Ω				
Electric strength	kV/mm	IEC 60243-1	⩾ 60 × ⩾ 60 × 1	M or Q	Use spherical electrodes of 20 mm diameter. Short-time test, voltage rate 2 kV/s. Immerse in transformer oil conforming to IEC 60296.
Comparative tracking index (CTI)	—	IEC 60112	⩾ 15 × ⩾ 15 × 4	M	Use test solution A
Other properties					
Water absorption	%	ISO 62	Thickness ⩾ 1	M	Measure saturation value at 23 °C immersed in water and equilibrium value at 23 °C/50 % relative humidity
Density	kg/m^3	ISO 1183	⩾ 10 × ⩾ 10 × 4		

[a] M = Injection moulding
Q = Compression moulding (compression-moulded sheets are used if injection-moulded specimens cannot be manufactured due to insufficient flowability to fill the mould).