
International Standard



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**Plastics — Polycarbonate moulding and extrusion materials —
Part 2: Preparation of test specimens and determination of properties**

Plastiques — Matériaux polycarbonates pour moulage et extrusion — Partie 2: Préparation des éprouvettes et détermination des caractéristiques

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7391/2 was prepared by Technical Committee ISO/TC 61, *Plastics*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Plastics — Polycarbonate moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope and field of application

1.1 This part of ISO 7391 specifies procedures for moulding test specimens of polycarbonate materials in a specified state and methods for measuring their properties.

1.2 No figures are quoted for these properties. Those required for the designation of polycarbonate materials for moulding and extrusion are given in ISO 7391/1. Other properties shall be determined by the appropriate methods referred to in this part of ISO 7391 and values may be obtained from manufacturer's literature. They can be directly compared if the procedures described herein for preparing the test specimens and for determining the properties are followed.

1.3 The values determined according to this part of ISO 7391 will not necessarily be identical to those obtained using specimens of different dimensions and/or prepared by different procedures. They may also be influenced by colourants and other additives. The values obtained for the properties of a moulding depend on the moulding compound, the shape, the test method and the state or anisotropy. The latter depends on the gating and the moulding conditions, for example temperature, pressure or injection rate. Any subsequent treatment must also be considered, for example conditioning or annealing.

1.4 The thermal history and the internal stresses of the specimens may strongly influence thermal and mechanical properties and resistance to environmental stress cracking, but exert less effect on the electrical properties, which mainly depend on the chemical composition of the moulding compound.

2 References

ISO 62, *Plastics — Determination of water absorption.*

ISO 75, *Plastics and ebonite — Determination of temperature of deflection under load.*

ISO 175, *Plastics — Determination of the effects of liquid chemicals including water.*

ISO 178, *Plastics — Determination of flexural properties of rigid plastics.*

ISO 179, *Plastics — Determination of Charpy impact strength of rigid materials.*

ISO 180, *Plastics — Determination of Izod impact strength of rigid materials.*

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

ISO 293, *Plastics — Recommended practice for compression moulding test specimens of thermoplastic materials.*¹⁾

ISO 294, *Plastics — Injection moulding test specimens of thermoplastic materials.*²⁾

ISO 306, *Plastics — Determination of the Vicat softening temperature of thermoplastics.*

ISO 527, *Plastics — Determination of tensile properties.*³⁾

ISO 537, *Plastics — Testing with the torsion pendulum.*

ISO 899, *Plastics — Determination of tensile creep.*

ISO 1133, *Plastics — Determination of the melt flow rate of thermoplastics.*

ISO 1183, *Plastics — Methods for determining the density and relative density (specific gravity) of plastics, excluding cellular plastics.*⁴⁾

ISO 1628/4, *Plastics — Determination of the viscosity number and limiting viscosity number — Part 4: Polycarbonate (PC) moulding and extrusion materials.*⁵⁾

ISO 2556, *Plastics — Determination of the gas transmission rate of films and thin sheets under atmospheric pressure — Manometric method.*

1) At present at the stage of draft. (Revision of ISO 293-1974.)

2) At present at the stage of draft. (Revision of ISO 294-1975.)

3) At present at the stage of draft. (Revision of ISO/R 527-1966.)

4) At present at the stage of draft. (Revision of ISO/R 1183-1970.)

5) At present at the stage of draft.

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

ISO 3451/1, *Plastics — Determination of ash — Part 1: General methods.*

ISO 7391/1, *Plastics — Polycarbonate moulding and extrusion materials — Part 1: Designation.*¹⁾

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

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

IEC Publication 243, *Recommended methods of test for electric strength of solid insulating materials at power frequencies.*

IEC Publication 250, *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.*

3 Determination of material properties

3.1 Melt flow rate

The melt flow rate shall be determined according to ISO 1133 using a test temperature of 300 °C and a nominal load of 1,2 kg (MFR 300/1,2). Compounds that have absorbed moisture shall be predried for 6 h or more at 120 ± 5 °C in a drying cabinet. The test shall be repeated if the difference between the maximum and minimum values exceeds 15 % of the average value.

3.2 Viscosity number

The viscosity number shall be determined in accordance with ISO 1628/4.

3.3 Density

The density shall be determined in accordance with ISO 1183.

3.4 Inorganic filler content

The inorganic filler content shall be determined in accordance with method A of ISO 3451/1, but using a temperature of 600 to 650 °C.

4 Determination of properties of moulded test specimens

4.1 Preparation of test specimens

4.1.1 General

The specimens shall be prepared by injection moulding or by compression moulding.²⁾

1) At present at the stage of draft.

2) Injection-moulded test specimens are preferred.

The PC materials shall be dried in accordance with the manufacturer's instructions before moulding the test specimens.

4.1.2 Injection moulding test specimens

Specimens shall be prepared by injection moulding according to ISO 294, using an end-gated mould. Single-impression moulds are preferable. The gate size shall be approximately equivalent to the thickness of the specimen.

The moulding conditions shall be characterized by the temperature of the mould, the average injection velocity of the melt and the melt temperature, as defined in ISO 294.

The following levels are recommended for unfilled PC materials and specimens with a thickness of 3-4 mm:

mould temperature : 80 °C

average injection velocity: $u = \frac{V}{t \times A} \approx 150 \text{ mm/s}$

where

V is the shot volume, in cubic millimetres;

t is the injection time, in seconds;

A is the cross-section, in square millimetres, of the essential part of the mould.

Deviations from these recommendations shall be stated in the test report.

The melt temperature shall be selected in accordance with the manufacturer's instructions and shall be stated in the test report.

NOTE — For specimens with a thickness less than 3 mm and/or filled PC materials, the required level of u may be greater than 150 mm/s.

4.1.3 Compression moulding test specimens

Specimens shall be prepared by compression moulding according to ISO 293, with the following moulding conditions:

moulding temperature : (VST/B + 30) °C

moulding pressure : 5 MPa

moulding time : 30 min

4.2 Conditioning of test specimens

The specimens for the determination of electrical properties shall be conditioned, in accordance with ISO 291, for at least 88 h at 23 ± 2 °C and 50 ± 5 % relative humidity. Test specimens for the determination of mechanical properties shall be conditioned for at least 4 h at 23 ± 2 °C.

4.3 Test methods

The properties quoted shall be determined using the specimens and methods referred to in the table. Specimens conditioned in a certain atmosphere shall be tested in the same atmosphere.

Table — Methods of test for moulded test specimens of polycarbonate materials

Property	Unit	Method	Type	Specimen dimensions, mm	Particulars
Mechanical properties					
Shear modulus	MPa	ISO 537		60 × 10 × 1 ²⁾	Frequency 0,1 to 10 Hz
Mechanical loss factor	—	ISO 537		60 × 10 × 1 ²⁾	Frequency 0,1 to 10 Hz
Tensile modulus of elasticity	MPa	ISO 527	B	150 × 10 × 4	Testing speed 1 mm/min
Tensile stress at break	MPa	ISO 527	B	150 × 10 × 4	Testing speed without filler: 50 mm/min with filler: 5 mm/min
Tensile elongation at break	%	ISO 527	B	150 × 10 × 4	Testing speed without filler: 50 mm/min with filler: 5 mm/min
Flexural stress at conventional deflection	MPa	ISO 178		80 × 10 × 4	Testing speed 2 mm/min
Impact strength Charpy ^{1) 5)}	kJ/m ²	ISO 179	1	80 × 10 × 4 ²⁾	Unfilled materials: type A notch Filled materials: unnotched
Impact strength Izod ^{1) 5)}	kJ/m ²	ISO 180	1	80 × 10 × 4 ²⁾	Type A notch
Creep strength limit (apparent modulus)	MPa	ISO 899		150 × 10 × 4 ²⁾	Time 1 000 h
Thermal properties					
Vicat softening temperature	°C	ISO 306, method B		25 × 25 × 4 ^{2) 3)}	Heating rate 50 °C/h
Temperature of deflection under load ²⁾	°C	ISO 75, method A or B		110 × 10 × 4	Heating rate 2 °C/min
Electrical properties					
Surface resistivity	Ω	IEC Publication 93		100 × 100 × 1,5 ²⁾	1 000 V measuring voltage
Volume resistivity	Ω · cm	IEC Publication 93		100 × 100 × 1,5 ²⁾	1 000 V measuring voltage
Electric strength	kV/mm	IEC Publication 243		100 × 100 × 0,8 ²⁾	AC voltage: 50 to 60 Hz; electrode: sphere diameter 20 mm, against plate under dibutylphthalate, rapidly applied
Relative permittivity, ϵ_r	—	IEC Publication 250		100 × 100 × 1,5 ²⁾	AC voltage, 1 kHz
Dissipation factor, $\tan \delta$	—	IEC Publication 250		100 × 100 × 1,5 ²⁾	AC voltage, 1 kHz
Comparative tracking index	—	IEC Publication 112		50 × 50 × 3 ²⁾	AC voltage, 50 to 60 Hz
Miscellaneous properties					
Gas transmission rate	cm ³ / (m ² · d · atm) ⁴⁾	ISO 2556		Sheet 0,1	—
Water absorption	—	ISO 62, method 1		Disc ϕ 50 × 3	—
Effect of liquid chemicals	—	ISO 175		Disc ϕ 50 × 3	Immersion time 7 days

1) Property used for material designation in ISO 7391/1.

2) Specimens of other dimensions may be used when they give the same results or when it is impossible to mould the specified test specimens.

3) May be machined (see ISO 2818).

4) $1 \text{ cm}^3/(\text{m}^2 \cdot \text{d} \cdot \text{atm}) = 0,114 3 \text{ fm}/(\text{Pa} \cdot \text{s})$

5) For notching the specimen, use a sharp single-tooth tool. The surface of the notch shall be smooth as viewed by means of a X10 magnifying glass.