INTERNATIONAL STANDARD

ISO 7823-1

First edition
1987-04-01

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Plastics — Poly(methyl methacrylate) sheets — Types, dimensions and characteristics —

Part 1 : Cast sheets

Plastiques — Plaques en poly(méthacrylate de méthyle) — Types, dimensions et caractéristiques —

Partie 1 : Plaques coulées

Reference number
ISO 7823-1 : 1987 (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.

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 7823-1 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.

Printed in Switzerland

Plastics — Poly(methyl methacrylate) sheets — Types, dimensions and characteristics —

Part 1 : Cast sheets

1 Scope and field of application

1.1 This part of ISO 7823 specifies requirements for non-modified flat poly(methylmethacrylate) (PMMA) cast sheets (cell and continuous), colourless and coloured, transparent, translucent and opaque for general purpose use.

1.2 The thickness range of the sheets covered by this part of ISO 7823 is 1,5 to 25 mm.

2 References

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

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

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

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

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

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

ISO/R 489, *Plastics — Determination of the refractive index of transparent plastics.*

ISO 527, *Plastics — Determination of tensile properties.* [1)]

ISO 1183, *Plastics — Methods for determining the density and relative density (specific gravity) of plastics, excluding cellular plastics.* [2)]

ISO 2039-2, *Plastics and ebonite — Determination of hardness — Part 2 : Rockwell hardness.*

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

ISO 2859, *Sampling procedures and tables for inspection by attributes.*

ISO 3557, *Plastics — Recommended practice for spectrophotometry and calculation of colour in CIE systems.* [3)]

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering and artificial light.*

ISO 4607, *Plastics — Method of exposure to natural weathering.*

ISO 4892, *Plastics — Methods of exposure to laboratory light sources.*

EN 2155-9, *Determination of haze.*

EN 2155-12, *Determination of coefficient of linear thermal expansion.*

3 Definitions

For the purpose of this part of ISO 7823, the following definitions apply.

3.1 non-modified cast PMMA sheets : Sheets based on homopolymers of MMA and copolymers of MMA with acrylic or methacrylic monomers produced by bulk polymerization in the presence of suitable initiators.

3.2 flat PMMA sheets : Sheets with substantially parallel plane surfaces.

4 Composition

4.1 The content of plasticizing ingredients (materials that do not undergo chemical reaction to become part of the polymer), other monomers and crosslinking agents shall be present in an amount that does not change the basic properties from those shown in table 4. This amount is in most cases less than 3 % (m/m).

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

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

3) At present at the stage of draft.

4.2 Other additives, e.g. colorants, UV absorbers, pigments, etc., may be included to achieve specific properties.

5 General requirements

5.1 Unless otherwise agreed between the interested parties, the surfaces of the sheet, as delivered, shall be protected by suitable material, for example kraft paper secured with a water-soluble or pressure-sensitive adhesive readily removed without surface contamination or damage or by polyethylene film.

5.2 Appearance

5.2.1 Surface defects

The sheet shall have a smooth surface. There shall be no surface defects, scratches or marks larger than 3 mm^2 anywhere on the sheet.

5.2.2 Inclusion defects

There shall be no bubbles, inclusions, cracks or other defects that could adversely affect the performance of the sheet in its intended application, larger than 3 mm^2 anywhere in the sheet.

5.2.3 Classification

The area of defects found in the sheet shall be classified as specified in table 1. Each defect shall be considered separately.

Table 1 — Classification of defects

Classification	Surface defects	Inclusion defects
Negligible	Less than 1 mm^2	Less than 1 mm^2
Acceptable	1 to 3 mm^2	1 to 3 mm^2

5.2.4 Defects distribution

5.2.4.1 There shall not be a significant (for the application) amount of fine inclusion defects, each particle of which is defined as negligible in table 1, within 1 m^2 anywhere in the sheet.

5.2.4.2 No defect defined as acceptable in table 1 shall be within 500 mm of another acceptable defect anywhere in or on the sheet.

5.3 Colour

Unless otherwise specified, colour distribution shall be homogeneous. Admissible variation shall be agreed between the interested parties.

5.4 Dimensions

5.4.1 Length and width

The length and width of the sheets shall be agreed between the interested parties. The tolerances are specified in table 2.

Table 2 — Tolerances on length and width

Length or width mm	Tolerance mm
Up to 1 000	$^{+3}_{0}$
from 1 001 to 2 000	$^{+6}_{0}$
from 2 001 to 3 000	$^{+9}_{0}$
3 001 and over	$^{+0,3\ \%}_{0}$

5.4.2 Thickness

Standard thickness and tolerances specified in table 3 are for sheets up to 5 m^2 in area (e.g. sheet size 2,5 m × 2 m).

Tolerances are intended within each sheet and from sheet to sheet.

Table 3 — Tolerances on thickness

Thickness mm	Tolerances mm	Thickness mm	Tolerances mm
1,5	±0,4	6,0	±1,0
2,0	±0,4	8,0	±1,2
2,5	±0,5	10,0	±1,3
3,0	±0,6	12,0	±1,6
4,0	±0,8	15,0	±1,6
5,0	±0,9	20,0	±1,6
		25,0	±1,6

5.4.3 Tolerances

Tolerances for sheet sizes and thicknesses outside the above range shall be agreed between the interested parties.

5.4.4 Test conditions

Measurements of the dimensions of the sheets shall be made at room temperature, except that in case of dispute the measurements shall be made under standard conditions, as specified in ISO 291. For measurements made under local ambient conditions, due allowance should be made for dimensional changes due to the differences in temperature and relative humidity between test locations.

5.5 Basic properties

The mechanical, thermal and optical properties of the sheets shall be as specified in table 4.

5.6 Special properties

Requirements may be agreed between the interested parties for special properties needed for particular applications. Examples of such properties are presented in table 5.

6 Test methods

6.1 General

6.1.1 Sampling

A sample sufficient to determine the compliance of the material to this specification shall be selected according to ISO 2859 at random from each lot of material.

6.1.2 Conditioning and testing of test specimens

The conditioning of the specimens (48 h) and the tests shall be carried out in accordance with ISO 291 at 23 ± 2 °C and (50 ± 5)% R.H., except for Vicat softening point and deflection temperature (see 6.6.1 and 6.6.2).

6.1.3 Preparation of test specimens

Test specimens shall be prepared in accordance with the procedures laid down in ISO 2818 wherever applicable. When it is necessary to machine the sheet to reduce it to the dimensions required for a particular test method, one original surface shall be left intact.

6.2 Appearance

The defects and their distribution shall be evaluated by inspecting the sheet illuminated by daylight-type fluorescent lamp with colour temperature of 6 500 ± 650 K, of not less than 40 W.

6.3 Colour

Colour differences between a reference material (standard) and the test samples shall be determined using a differential colorimetric instrument, as agreed between the interested parties.

6.4 Dimensions

6.4.1 Length and width of the sheets shall be measured to the nearest 0,5 mm in accordance with 5.4.4, using a calibrated rule.

6.4.2 Thickness of the sheets shall be measured, using a gauge, calibrated micrometer or dial to the nearest 0,05 mm in accordance with 5.4.4, excluding the surface protective covering and without damaging the surface. Measurements shall be carried out at not less than 100 mm from the sheet edge.

6.5 Mechanical properties

6.5.1 Flexural properties[1] shall be determined according to ISO 178. The original surface shall be put into tension whenever the specimen has been machined to conform with the specified dimensions.

6.5.2 Tensile properties[1] shall be determined according to ISO 527, type 1 specimen, speed B.

6.5.3 Impact strength (Charpy) shall be determined according to ISO 179, using the standard unnotched bar 50 mm × 6 mm × 4 mm or 80 mm × 10 mm × 4 mm. The pendulum shall strike the surface opposite to the original one whenever the specimen has been machined to conform with the specified dimensions.[2]

6.5.4 Rockwell hardness shall be determined according to ISO 2039-2, scale M, using the original cast surface for test.

6.6 Thermal properties

6.6.1 Vicat softening point shall be determined according to ISO 306, Method B, using the original cast surface. The rate of heating shall be 50 °C/h.

Prior to the test, the specimens shall be conditioned at 80 ± 2 °C for 16 h and cooled down to room temperature in a desiccator.

6.6.2 Deflection temperature under load shall be determined according to ISO 75, Method A. Prior to the test, the specimens shall be conditioned at 80 ± 2 °C for 16 h and cooled down to room temperature in a desiccator.[3]

6.6.3 Dimensional change at elevated temperature (shrinkage) shall be determined according to the method described in the annex.

6.6.4 Coefficient of linear thermal expansion shall be determined according to EN 2155-12.

6.7 Flammability

Flammability and burning properties shall be determined according to national fire regulations.

6.8 Optical properties

6.8.1 Light transmittance shall be determined by light source D 65 according to ISO 3557, using an integrating sphere, on specimens 1,5 to 5 mm thick.

1) When the sheet has a thickness lower than that required for the specimen by the relevant test method, specimens having the thickness of the sheet shall be used.

2) Other types of specimens, according to ISO 179, may be used, as agreed between the interested parties.

3) For sheets thinner than 3 mm only the Vicat softening point shall only be determined.

6.8.2 Haze shall be determined according to EN 2155-9 in the range 380 to 780 nm on specimens 1,5 to 5 mm thick.

6.8.3 Light transmittance at 420 nm, before and after exposure for 1 000 h to a xenon lamp according to ISO 4892, shall be determined by a spectrophotometric system, using a specimen 1,5 mm to 5 mm thick. By agreement of the interested parties, light transmittance may alternatively be determined after exposure to the carbon arc lamp.

6.8.4 Refractive index shall be determined according to ISO 489, method A.

6.9 Special properties

6.9.1 Density shall be determined according to ISO/R 1183, method A.

6.9.2 Water absorption shall be determined according to ISO 62, method 1, 24 h at 23 °C.

6.9.3 Natural weathering performance shall be determined according to ISO 4607; resistance to exposure to artificial light shall be determined according to ISO 4892; changes in colour and properties after exposure shall be determined according to ISO 4582. The details of these tests shall be agreed upon by the interested parties.

7 Retest and rejection

If any failure occurs, the material may be retested by agreement between the interested parties.

Table 4 — Requirements for basic properties

Property	Unit	Test method	Value	Subclause
Tensile strength, min.	MPa	ISO 527, type 1 specimen, speed B	70	6.5.2
Modulus of elasticity in tension, min.	MPa	ISO 527, type 1 specimen, speed B	3 000	6.5.2
Elongation at break, min.	%	ISO 527, type 1 specimen, speed B	4	6.5.2
Impact strength (Charpy), min.	kJ/m^2	ISO 179/2D	10	6.5.3
Vicat softening temperature, min.	°C	ISO 306, method B, 5 kg	105	6.6.1
Dimensional change on heating (shrinkage), max.	%	Annex	2,5	6.6.3
Light transmission, min.	%	ISO 3557	90 [1]	6.8.1
Light transmission at 420 nm, min.	%	ISO 3557	90 [1]	6.8.3
Light transmission at 420 nm after exposure to xenon lamp for 1 000h, min.	%	ISO 3557	88 [1]	6.8.3

1) For transparent colourless material.

Table 5 — Typical values for special properties

Property	Unit	Test method	Typical value	Subclause
Flexural strength	MPa	ISO 178	110	6.5.1
Rockwell hardness (M scale)		ISO 2039/2	100	6.5.4
Coefficient of linear expansion	K^{-1}	EN 2155-12	70×10^{-6}	6.6.4
Deflection temperature under load	°C	ISO 75, method A, 1,8 MPa	98	6.6.2
Haze	%	EN 2155-9	1	6.8.2
Refractive index, n_D^{20}	—	ISO 489, method A	1,492	6.8.4
Density (colourless sheet)	g/cm^3	ISO 1183, method A	1,18	6.9.1
Water absorption	%	ISO 62, method 1	0,5	6.9.2

Annex

Determination of dimensional change at elevated temperature (shrinkage)

(This annex forms an integral part of the Standard.)

A.1 Cut three or more square test specimens of side 100 ± 2 mm from the sample sheet at positions approximately equally spaced across the width of the sample. Dry the test specimens at 70 ± 2 °C for 48 h and then cool them down to room temperature in a desiccator (18 to 28 °C; in case of dispute 23 ± 2 °C). Mark the four sides and measure these to the nearest 0,02 mm.

A.2 Place the test specimens horizontally on a plane plate on a shelf in an oven, controlled at 160 ± 2 °C. To avoid sticking of the specimens, cover the supporting plate with a 3 mm thick layer of talc. The time of heating, depending on the thickness of the sheet, shall be as follows :

Thickness, mm	**Time**, min
1,5 to 5	60
> 5	75

A.3 Cool the test specimens to room temperature in a desiccator (18 to 28 °C; in case of dispute 23 ± 2 °C) and measure the four sides again to the nearest 0,02 mm.

A.4 Calculate the change of length of each side of each test specimen as a percentage of the initial value. Calculate the average percentage change for the four sides of each test specimen and the average value for the set of three specimens.

A.5 Report the presence of bubbles and cracks, and any other change in appearance of the test specimens.

UDC 678-415 : 678.744.335

Descriptors : plastics, polymers, methylmethacrylate, castings, plastic sheets, specifications, dimensions, properties.

Price based on 5 pages