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Plastics — Poly(methyl methacrylate) (PMMA) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

Plastiques — Matériaux à base de poly(méthacrylate de méthyle) (PMMA) pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 24026-2 cancels and replaces ISO 8257-2:2001, which has been technically revised.

The main changes compared to the previous edition are as follows:

— the normative references have been updated;

— Clause 3 has been added;

— the contents of Table 3 and Table 4 have been updated.

A list of all parts in the ISO 24026 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Plastics — Poly(methyl methacrylate) (PMMA) moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

1 Scope

1.1 This document specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of poly(methyl methacrylate) (PMMA) moulding and extrusion materials. It gives the requirements for handling test material and for conditioning both the test material before moulding and the specimens before testing.

1.2 This document specifies procedures and conditions for the preparation of test specimens and procedures for measuring properties of the materials from which these specimens are made. It lists properties and test methods which are suitable and necessary to characterize poly(methyl methacrylate) moulding and extrusion materials.

1.3 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 document, as are the designatory properties specified in ISO 24026-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 178, *Plastics — Determination of flexural properties*

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

ISO 179-2, *Plastics — Determination of Charpy impact properties — Part 2: Instrumented impact test*

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

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

ISO 489, *Plastics — Determination of refractive index*

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

ISO 604, *Plastics — Determination of compressive properties*

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

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

ISO 1628-6, *Plastics — Determination of viscosity number and limiting viscosity number — Part 6: Methyl methacrylate polymers*

ISO 2039-1, *Plastics — Determination of hardness — Part 1: Ball indentation method*

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

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 6721-2, *Plastics — Determination of dynamic mechanical properties — Part 2: Torsion-pendulum method*

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

ISO 13468-1, *Plastics — Determination of the total luminous transmittance of transparent materials — Part 1: Single-beam instrument*

ISO 24026-1, *Plastics — Poly(methyl methacrylate) (PMMA) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Preparation of test specimens

4.1 General

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 in this document. Values determined are necessarily identical to those obtained using specimens of different dimensions or prepared using different procedures.

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

4.2 Treatment of the material before moulding

Before processing, the moisture content of the material sample shall not exceed 0,05 % by mass. If the moisture level exceeds this limit, the sample shall be dried in accordance with the manufacturer's instructions until the moisture content no longer exceeds the limit.

4.3 Moulding of specimens

4.3.1 General requirements

The specimens shall be prepared by injection moulding in accordance with ISO 294-1, using the conditions specified in 4.3.2 to 4.3.6.

4.3.2 Melt temperature

4.3.2.1 General

PMMA moulding compounds are designated using a code-number representing the value of the Vicat softening temperature (VST), a code-number representing the value of the melt mass-flow rate (MFR) and, optionally, a code-number representing the value of the viscosity number (VN). For details of this designation system, in particular the code-numbers used, see ISO 24026-1. In cases where the designation only includes code-numbers for VST and MFR, the melt temperature used for moulding test specimens may be determined from the MFR code-number (see 4.3.2.2). If the code-number for VN is also used in the designation, the melt temperature may also be determined from the VST and VN code-numbers (see 4.3.2.3). It should be noted that, for moulding compounds with MFR values lying between 1 g/10 min (code-number 015) and 16 g/10 min (code-number 120), there is little difference in the melt temperatures calculated from the MFR code-number and those calculated from the VST and VN code-numbers. However, for moulding compounds outside this range, the melt temperature shall be determined only from the VST and VN code-numbers.

When preparing specimens, the melt temperature shall be kept constant to within ± 3 °C.

4.3.2.2 Melt temperature determined from MFR code-number

Select the appropriate melt temperature from Table 1.

Table 1 — Melt temperature as function of MFR code-number

MFR code-number	Melt temperature °C
005	270
015	260
030	250
060	240
120	230
240	220

EXAMPLE

Moulding-compound designation: ISO 24026-PMMA,MLN,108-030

Melt temperature = 250 °C

4.3.2.3 Melt temperature determined from VST and VN code-numbers

Calculate the melt temperature, in degrees Celsius, using Formula (1):

$$T_M = T_{VS} + 130 + a_{VN} \quad (1)$$

where

T_M is the melt temperature;

T_{VS} is the VST code number;

a_{VN} is a number which depends on the VN code-number as shown in Table 2.

Table 2 — Value of a_{VN} as a function of VN code-number

VN code-number	a_{VN}
43	0
53	10
63	20
73	30
83	40
93	50

EXAMPLE

Moulding-compound designation: ISO 24026-PMMA,MLN,108-030-53

Melt temperature = 108 + 130 + 10 = 248 °C

4.3.3 Mould temperature

Calculate the mould temperature, in degrees Celsius, using Formula (2):

$$T_c = T_{VS} - 40 \quad (2)$$

where

T_c is the mould temperature;

T_{VS} is the VST code number.

The mould temperature shall be kept constant to within ± 3 °C.

EXAMPLE

Moulding-compound designation: ISO 24026-PMMA,MLN,108-030-53

Mould temperature = 68 °C

4.3.4 Average melt velocity

Set the injection pressure to give an average melt velocity of 200 mm/s ± 100 mm/s.

4.3.5 Hold pressure

Set the hold pressure to a value such that test specimens with only very slight sink marks are obtained.

4.3.6 Cooling time

Use a cooling time of 50 s ± 5 s.

5 Conditioning of test specimens

Test specimens shall be conditioned in an oven for 16 h at a temperature of (VST code-number-25) °C. The conditioning temperature shall be kept constant to within ± 3 °C.

After conditioning in the oven, the specimens shall be further conditioned for at least 24 h at (23 ± 2) °C and (50 ± 10) % relative humidity, except for specimens to be used for the determination of certain thermal and "other" properties, as given in Tables 2 and 3, which, after conditioning in the oven, shall be allowed to cool for at least 1 h at (23 ± 2) °C in a desiccator. Testing shall be performed immediately after the specimens are removed from the desiccator.

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 ± 10) % 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 PMMA 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 PMMA moulding and extrusion materials.