International Standard 2580/2

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Plastics — Acrylonitrile/butadiene/styrene (ABS) moulding and extrusion materials — Part 2 : Determination of properties

Plastiques — Plastiques à base d'acrylonitrile/butadiène/styrène (ABS) pour moulage et extrusion — Partie 2 : 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.

International Standard ISO 2580/2 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in March 1980.

It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	Poland
Austria	Hungary	Romania
Belgium	India	South Africa, Rep. of
Brazil	Ireland	Spain
Canada	Israel	Sweden
China	Italy	Switzerland
Egypt, Arab Rep. of	Korea, Rep. of	United Kingdom
Finland	Mexico	USA
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The member body of the following country expressed disapproval of the document on technical grounds :

Japan

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Plastics — Acrylonitrile/butadiene/styrene (ABS) moulding and extrusion materials — Part 2 : Determination of properties

1 Scope and field of application

This International Standard specifies procedures for moulding test specimens of acrylonitrile/butadiene/styrene (ABS) compounds in a specified state and methods for measuring their properties. Any property listed in part 2 and referred to in combination with part 1 shall be determined by the method referred to in part 2.

No figures are quoted for these properties. Those required for the designation of ABS compounds are given in ISO 2580/1. Other properties shall be determined by the appropriate methods referred to in this International Standard and values may be obtained from manufacturers' literature. They can be directly compared if the procedures described herein for preparing the test specimens and for determining the properties are followed.

NOTE — The moulding procedures and test methods described in this International Standard can, by agreement, also be used for the preparation and testing of specimens made from other impact-resistant acrylonitrile/styrene terpolymer (AXS) moulding and extrusion materials (ASA, AES, ACS).

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, *Rigid plastics — Determination of the Charpy impact strength.*[1)]

ISO 180, *Rigid plastics — Determination of the Izod impact strength.*[2)]

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

ISO 293, *Plastics — Recommended practice for compression moulding of test specimens of thermoplastic materials.*[3)]

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

ISO 527, *Plastics — Determination of tensile properties.*[4)]

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

ISO 604, *Plastics — Determination of compressive properties.*

ISO 1133, *Plastics — Determination of the melt flow rate of thermoplastics.*[5)]

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

ISO 1656, *Raw natural rubber and natural rubber latex — Determination of nitrogen.*

ISO 2039, *Plastics and ebonite — Determination of hardness by the ball indentation method.*

ISO 2039/2, *Plastics — Determination of hardness by the ball indentation method — Part 2 : Rockwell hardness.*

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

ISO 2557, *Plastics — Amorphous thermoplastic moulding materials — Preparation of test specimens with a defined level of shrinkage.*

ISO 2561, *Plastics — Determination of residual styrene monomer in polystyrene by gas chromatography.*

ISO 2580/1, *Plastics — Acrylonitrile/butadiene/styrene (ABS) moulding and extrusion materials — Part 1 : Designation.*

1) At present at the stage of draft. (Revision of ISO/R 179.)

2) At present at the stage of draft. (Revision of ISO/R 180.)

3) At present at the stage of draft. (Revision of ISO 293.)

4) At present at the stage of draft. (Revision of ISO/R 527.)

5) At present at the stage of draft. (Revision of ISO/R 292 and ISO/R 1133.)

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

ISO 3167, *Plastics — Preparation and use of multipurpose test specimens.*

ISO 4581, *Plastics — Styrene/acrylonitrile copolymers — Determination of residual acrylonitrile monomer content — Gas chromatographic method.* [1)]

ISO 4600, *Plastics — Determination of environmental stress-cracking (ESC) — Ball or pin impression method.*

IEC Publication 93, *Recommended methods of test for volume and surface resistivities of electrical insulation materials.*

IEC Publication 112, *Recommended method for determining the comparative tracking index 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 Properties

The values determined according to this International Standard will not necessarily be identical to those obtained using test specimens of different dimensions and/or prepared by different procedures. They may also be influenced by colorants 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 of the mould and the moulding conditions, for example temperature, pressure or injection rate. Any subsequent treatment must also be considered, for example conditioning or annealing.

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

In order to obtain reproducible test results the two following conditions shall be met :

a) test specimens with the specified dimensions and state;

b) test procedures as specified in this International Standard.

4 Preparation of specimens

4.1 General

The test specimens shall be either prepared with a longitudinal orientation (defined state) by injection moulding according to ISO 2557 or prepared in the basic state by compression moulding according to ISO 293 or by thermal relaxation of injection-moulded test specimens as described in ISO 2557. Test specimens with a longitudinal orientation shall be injection moulded separately and not machined from moulded plates. Whenever possible use the multipurpose test specimen or parts thereof described in ISO 3167. Before it is processed, the moulding compound shall be predried according to 4.3 or to the specification of the manufacturer; in the latter case, the conditions shall be stated in the test report.

4.2 State of the specimens

4.2.1 Defined state

Longitudinal oriented specimens shall be injection moulded in a mould with a frontal gate. The minimum dimension of the gate should be at least equal to the minimum dimension of the specimen. The moulding conditions depend upon the size of the specimens, the moulding machine and the moulding compound. They should be set so that the maximum shrinkage, as measured in accordance with ISO 2557, S_m (170 °C, 15 min, in air), in the trimmed 30 mm central part of the specimen, is 30 ± 10 %.

4.2.2 Basic state

Specimens in the basic state, i.e., nearly free of internal stresses and orientations, shall be machined from compression moulded sheet or prepared by thermal relaxation of injection-moulded specimens.

The specimens shall be considered to be in their basic state if, after 15 min at 170 ° C in air :

a) the structure of their surface does not change;

b) the values of their properties are known not to change as a result of the heat treatment;

c) their maximum shrinkage is less than 5 % :

S_m = 0 to 5 % (170 °C, 15 min in air)

4.2.2.1 Compression moulding of sheet

A quantity, 5 % more than required to fill the mould cavity, is preplasticized by a two-roll-mill or other suitable device. For milling (see note 2) the following conditions are recommended :

Temperature of the rollers : 130 to 140 °C and
150 to 160 °C, respectively

Time : 5 to 6 min.

1) At present at the stage of draft.

The resulting milled plastic is folded to a preform of the approximate shape of the mould and put into the mould preheated to 180 °C. This should be done as quickly as possible.

The conditions for compression moulding shall be adapted to the presses, moulds and moulding compounds. The following starting conditions are recommended :

Temperature : 180 °C

Pre-heating time : 5 min (approximate)

Pressure : 4 MPa* (for each square millimetre of area of the moulding)

Moulding time : 5 min

Rate of cooling (see note 1) : 10 ± 5 K/min (under pressure)

Demoulding at : ⩽ 60 °C

NOTES

1 Coolant with constant flow and temperature; resulting cooling time between 8 and 24 min.

2 The roll milling may be omitted when the basic state can be attained without premilling.

From the resulting sheet, test specimens shall be machined according to ISO 2818 for the determination of maximum shrinkage and the properties given in the table.

The maximum shrinkage shall be determined with specimens 30 mm × 10 mm × 4 mm cut from the central part of a sheet 4 mm thick.

4.2.2.2 Thermal relaxation

The conditions for thermal relaxation shall be adapted to the presses, moulds and moulding materials. The following conditions are recommended :

Temperature : 160 to 180 °C

Pressure : 0,5 to 1 MPa

Relaxation time (see the note) : up to 60 min

Rate of cooling : 10 ± 5 K/min (under pressure)

Demoulding at : ⩽ 60 °C

NOTE — When a longer relaxation time is necessary, verify that no thermal degradation has taken place, for example by the determination of the swelling index.[1)]

4.3 Conditioning

The moulding material shall be predried for 4 h in an oven at 80 °C. If not used immediately, it shall be stored so that moisture is excluded. Test specimens shall be stored after moulding in a desiccator at 23 ± 2 °C until tested.

Test specimens that have been in contact with air for some time or of which the moisture content is unknown shall be conditioned by one of the following methods and the method used shall be indicated in the test report :

Method A — Four hours drying at 80 °C. Then the test specimens shall be stored in a desiccator at 23 ± 2 °C prior to testing. This method shall be used for obtaining data for comparing materials, for test specimens of unknown exposure history and in case of dispute.

Method B — At least 16 h conditioning at 23 ± 2 °C and 50 ± 5 % relative humidity. These conditions may be used for routine testing if agreed between the interested parties. Method B cannot be used in case of dispute.

5 Test methods

5.1 General

The properties quoted shall be determined using the specimens and test methods given in the table. All measurements shall be made at 23 ± 2 °C and 50 ± 5 % relative humidity, unless otherwise stated in the relevant International Standard.

If the values for the properties have been determined on specimens with defined longitudinal shrinkage, this shall be stated. For instance, Charpy impact strength, unnotched, determined on specimens with a longitudinal shrinkage of 30 % :

Charpy impact strength (unnotched, S_m = 30 %) = 50 kJ/m².

Charpy impact strength, unnotched, determined on specimens in the basic state, i.e., with a longitudinal shrinkage of 0 to 5 % :

Charpy impact strength (unnotched, S_m = 0 to 5 %) = 20 kJ/m².

5.2 Determination of the bound acrylonitrile content in the continuous phase of ABS plastics

5.2.1 Principle

Separation of the continuous-phase non-grafted resin from the dispersed elastomeric phase in the ABS plastic, determination of the nitrogen content of this resin, and calculation of the acrylonitrile content of the continuous phase of the ABS plastic.

* 1 MPa = 1 N/mm²

1) Stein, D.J., Fahrbach, G., Adler, H., *Angewandte Makromolekulare Chemie* Vol. 38 (1974) pp. 67-79.

5.2.2 Procedure

5.2.2.1 Pre-extraction with *n*-hexane

Extract the dried particles (approximately 3 mm × 3 mm × 3 mm) of the ABS with *n*-hexane for about 80 h in a Soxhlet apparatus. During this time, additives such as anti-oxidants and lubricants will be removed. Dry the residue under vacuum at 60 °C.

5.2.2.2 Extraction with acetone

Extract 1,2 g of the ABS residue (5.2.2.1) with 50 ml of acetone, with occasional stirring, for 24 h at room temperature. Centrifuge the dispersion to separate the clear solution of the resin from the insoluble residue; for example 20 000 rev/min for 40 min is satisfactory. Extract the residue several times with acetone and separate by centrifuging. The combined acetone solution contains quantitatively the non-grafted resin, which can be precipitated by pouring it into a tenfold volume of methanol at − 10 °C. Dry the precipitated resin under vacuum at 60 °C.

NOTE — Any other method may be used provided it gives the same result. In such a case the method used shall be indicated in the test report.

5.2.2.3 Acrylonitrile content

Determine the nitrogen content of the precipitated resin by the Kjeldahl semi-micro method described in ISO 1656. Calculate the acrylonitrile content from the nitrogen content by the formula

$$AN = 3{,}79\ N$$

where

AN is the acrylonitrile content, expressed as a percentage by mass;

N is the nitrogen content, expressed as a percentage by mass.

NOTE — Any other method for the determination of nitrogen may be used, provided it gives the same result. In such a case the method used shall be reported.