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Plastics — Impact-resistant acrylonitrile/styrene (ASA, AES, ACS) moulding and extrusion materials, excluding butadiene-modified materials —

Part 2:
Preparation of test specimens and determination of properties

Plastiques — Thermoplastiques à base d'acrylonitrile/styrène sans butadiène (ASA, AES, ACS), résistants au choc, pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

Reference number
ISO 6402-2:1994(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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

International Standard ISO 6402-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

ISO 6402 consists of the following parts, under the general title *Plastics — Impact-resistant acrylonitrile/styrene (ASA, AES, ACS) moulding and extrusion materials, excluding butadiene-modified materials*:

- *Part 1: Designation*
- *Part 2: Preparation of test specimens and determination of properties*

Annex A forms an integral part of this part of ISO 6402.

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Plastics — Impact-resistant acrylonitrile/styrene (ASA, AES, ACS) moulding and extrusion materials, excluding butadiene-modified materials —

Part 2:
Preparation of test specimens and determination of properties

1 Scope

This part of ISO 6402 specifies the methods of preparation of test specimens and the test methods to be used in determining the properties of ASA, AES, ACS 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 ASA, AES, ACS moulding and extrusion materials are listed.

The properties have been selected from the general test methods in ISO 10350. 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 6402, as are the designatory properties specified in part 1: Vicat softening temperature, melt flow rate, impact strength and flexural modulus.

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 herein. Values determined will not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6402. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6402 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 62:1980, *Plastics — Determination of water absorption.*

ISO 75-1:1993, *Plastics — Determination of temperature of deflection under load — Part 1: General test method.*

ISO 75-2:1993, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite.*

ISO 178:1993, *Plastics — Determination of flexural properties.*

ISO 179:1993, *Plastics — Determination of Charpy impact strength.*

ISO 180:1993, *Plastics — Determination of Izod impact strength.*

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 293:1986, *Plastics — Compression moulding test specimens of thermoplastic materials.*

ISO 294:—[1], *Plastics — Injection moulding of test specimens of thermoplastic materials.*

ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*

ISO 527-1:1993, *Plastics — Determination of tensile properties — Part 1: General principles.*

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

ISO 527-4:—[2], *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and anisotropic fibre-reinforced plastic composites.*

ISO 899-1:1993, *Plastics — Determination of creep behaviour — Part 1: Tensile creep.*

ISO 1133:1991, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 1210:1992, *Plastics — Determination of the burning behaviour of horizontal and vertical specimens in contact with a small-flame ignition source.*

ISO 1656:1988, *Rubber, raw natural, and rubber latex, natural — Determination of nitrogen content.*

ISO 2561:1974, *Plastics — Determination of residual styrene monomer in polystyrene by gas chromatography.*

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

ISO 3167:1993, *Plastics — Multipurpose test specimens.*

ISO 4581:1994, *Plastics — Styrene/acrylonitrile copolymers — Determination of residual acrylonitrile monomer content — Gas chromatography method.*

ISO 4589-2:—[2], *Plastics — Determination of flammability — Part 2: Determination of oxygen index (OI) at ambient temperature.*

ISO 4589-3:—[2], *Plastics — Determination of burning behaviour by oxygen index — Part 3: Elevated-temperature test.*

ISO 6402-1:1990, *Plastics — Impact-resistant acrylonitrile/styrene moulding and extrusion materials (ASA, AES, ACS), excluding butadiene-modified materials — Part 1: Designation.*

ISO 8256:1990, *Plastics — Determination of tensile-impact strength.*

ISO 10350:1993, *Plastics — Acquisition and presentation of comparable single-point data.*

IEC 93:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials.*

IEC 112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.*

IEC 243-1:1988, *Methods of test for electric strength of solid insulating materials — Part 1: Tests at power frequencies.*

IEC 250:1969, *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 296:1982, *Specification for unused mineral insulating oils for transformers and switchgear.*

IEC 1006:1991, *Methods of test for the determination of the glass transition temperature of electrical insulating materials.*

3 Preparation of test specimens

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).

1) To be published. (Revision of ISO 294:1975)

2) To be published.

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.

3.1 Treatment of the material before moulding

Before processing, no pretreatment of the material sample is normally necessary.

3.2 Injection moulding

Injection-moulded specimens shall be prepared in accordance with ISO 294, 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
All grades	250	60	200 ± 100

3.3 Compression moulding

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

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.

4 Conditioning of test specimens

Test specimens shall be conditioned in accordance with ISO 291 for at least 16 h at 23 °C ± 2 °C and (50 ± 5) % relative humidity.

5 Determination of properties

In the determination of properties and the presentation of data, the standards, supplementary instructions and notes given in ISO 10350 shall be applied. All tests shall be carried out in the standard atmosphere of 23 °C ± 2 °C and (50 ± 5) % relative humidity unless specifically stated otherwise in tables 3 and 4.

Table 3 is compiled from ISO 10350, and the properties listed are those which are appropriate to impact-resistant acrylonitrile/styrene 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 impact-resistant acrylonitrile/styrene moulding and extrusion materials.

NOTE 1 Izod impact strength is a designatory property in part 1 of this International Standard. However, after 1998 only Charpy impact strength will be used for designation, and consequently Izod impact strength will be cancelled.

Table 2 — Conditions for compression moulding of test specimens

Material	Moulding temperature °C	Cooling rate °C/min	Demoulding temperature °C	Full pressure MPa	Full pressure time min	Preheating time min
All grades	220	10	⩽ 60	4 ± 0,5	5 ± 1	5 ± 1

Table 3 — General properties and test conditions (selected from ISO 10350)

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Rheological properties					
Melt mass-flow rate	g/10 min	ISO 1133	Moulding compound	—	220 °C, load 10 kg
Melt volume-flow rate	cm^3/10 min				
Mechanical properties					
Tensile modulus	MPa	ISO 527-1, ISO 527-2, ISO 527-4	see ISO 3167	M	Test speed 1 mm/min
Yield stress	MPa				Test speed 50 mm/min
Yield strain	%				Test speed 50 mm/min
Strain at break	%				Test speed 50 mm/min
Stress at 50 % strain	MPa				Test speed 50 mm/min. Only to be quoted if no yielding is observed up to 50 % nominal strain
Tensile creep modulus	MPa	ISO 899-1	see ISO 3167	M	At 1 h; At 1 000 h: Strain ⩽ 0,5 %
Flexural modulus	MPa	ISO 178	see ISO 3167	M	Test speed 2 mm/min
Flexural strength	MPa				
Charpy impact strength	kJ/m^2	ISO 179	80 × 10 × 4	M	Method 1eU (edgewise impact)
Charpy notched impact strength	kJ/m^2		80 × 10 × 4 V-notch, $r = 0,25$	M	Method 1eA (edgewise impact)
Tensile notched impact strength	kJ/m^2	ISO 8256	80 × 10 × 4 double V-notch, $r = 1$	M	Only to be quoted if fracture cannot be obtained with notched Charpy test
Thermal properties					
Glass transition temperature	°C	IEC 1006	Moulding compound	—	Method A (DSC or DTA). Use 10 °C/min
Temperature of deflection under load	°C	ISO 75-1, ISO 75-2	110 × 10 × 4 or 80 × 10 × 4	M	0,45 MPa and 1,8 MPa
Vicat softening temperature	°C	ISO 306	10 × 10 × 4	M	Heating rate 50 °C/h, load 50 N
Flammability	mm/min	ISO 1210	125 × 13 × 3	M	Method A — linear burning rate of horizontal specimens
Ignitability	%	ISO 4589-2, ISO 4589-3	80 × 10 × 4	M	Procedure A — top surface ignition
Electrical properties					
Relative permittivity	—	IEC 250	⩾ 80 × ⩾ 80 × 1	Q	Frequency 100 Hz and 1 MHz (compensate for electrode edge effect)
Dissipation factor	—				
Volume resistivity	Ω·m	IEC 93	⩾ 80 × ⩾ 80 × 1	Q	Voltage 100 V
Surface resistivity	Ω				
Electric strength	kV/mm	IEC 243-1	⩾ 80 × ⩾ 80 × 1; ⩾ 80 × ⩾ 80 × 3	Q; M	Use 25 mm/75 mm coaxial-cylinder electrode configuration. Immerse in IEC 296 transformer oil. Use short time (rapid rise) test
Comparative tracking index	—	IEC 112	⩾ 15 × ⩾ 15 × 4	M	Use solution A

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Other properties					
Water absorption	%	ISO 62	50 × 50 square or ϕ 50 × 3 circle	M	24 h immersion in water at 23 °C
			Thickness ⩽ 1	Q	Saturation value in water at 23 °C
				Q	Saturation value at 23 °C and 50 % relative humidity
Density	kg/m³	IEC 1183	10 × 10 × 4	M	Specimen to be taken from moulded product
M = Injection moulding Q = Compression moulding					

Table 4 — Additional properties and test conditions of particular utility to ASA-I, AES-I, ACS-I moulding and extrusion materials

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation	Test conditions and supplementary instructions
Mechanical properties					
Izod impact strength	kJ/m²	ISO 180	80 × 10 × 4	M	
Other properties					
Residual-styrene-monomer content	%	ISO 2561	Moulding compound		
Residual-acrylonitrile content	%	ISO 4581	Moulding compound		
Bound-acrylonitrile content	%		Moulding compound		See annex A
M = Injection moulding					

Annex A
(normative)

Determination of the bound-acrylonitrile content in the continuous phase

A.1 Principle

The unbound resin in the continuous phase is separated from the dispersed elastomeric phase, the nitrogen content of this resin is determined and the acrylonitrile content of the continuous phase calculated.

A.2 Procedure

A.2.1 Pre-extraction with *n*-hexane

Extract the dried particles (approximately 3 mm × 3 mm × 3 mm) with *n*-hexane for about 80 h in a Soxhlet apparatus. During this time, additives such as antioxidants and lubricants will be removed. Dry the residue under vacuum at 60 °C for at least 2 h.

A.2.2 Extraction with acetone

Extract 1,2 g of residue obtained in A.2.1 with 50 cm^3 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 (20 000 rev/min for 40 min is satisfactory). Extract the residue several times with acetone and separate by centrifuging.

The combined acetone extracts contain all the unbound 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.

A.2.3 Acrylonitrile content

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

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

where

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

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

3,79 is the ratio of the relative molecular masses of acrylonitrile (C_2H_3CN) and nitrogen.

NOTE 2 Alternatively, the percentage acrylonitrile content may be determined by a pyrolysis/thermal-conductivity method.

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