INTERNATIONAL STANDARD 800

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

Plastics — Phenolic moulding materials — Specification

Plastiques — Matières à mouler phénoplastes — Spécifications

First edition — 1977-11-01

UDC 678.632

Ref. No. ISO 800-1977 (E)

Descriptors : plastics, phenoplasts, moulding materials, materials specifications, classifications, tests, physical properties, mechanical properties, electrical properties.

Price based on 4 pages

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 800 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in February 1976.

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

Australia	Hungary	Romania
Austria	Iran	South Africa, Rep. of
Belgium	Ireland	Spain
Brazil	Israel	Sweden
Canada	Mexico	Switzerland
Chile	Netherlands	Turkey
Czechoslovakia	New Zealand	United Kingdom
Finland	Poland	U.S.A.
Germany	Portugal	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
Italy

This International Standard cancels and replaces ISO Recommendation R 800-1968, of which it constitutes a technical revision.

Printed in Switzerland

Plastics — Phenolic moulding materials — Specification

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies requirements for the physical properties of phenolic moulding materials classified into types and grades according to their use and properties.

1.2 Types

Four types of material are specified as follows :

- Type A : General purpose;
- Type C : Heat resistant;
- Type D : Impact resistant;
- Type E : Electrical applications.

1.3 Filler

The type of filler to be used in each type of moulding material is not specified but is usually as shown in the following examples :

Type of material	Filler
A	Wood flour
C	Asbestos
D	Cotton
E	Mica

1.4 Resin

Abbreviations are used to indicate the type of phenolic resin, as follows :

- One-step phenolic resin : PF 1
- Two-step phenolic resin : PF 2

1.5 Grades

The various types of material are further sub-divided into grades based on property levels and requirements.

Example : PF 2A1 is a phenolic moulding material made from two-step resin, intended for general applications. The last digit indicates a particular grade of one type of material.

1.6 Classification

The following list shows the types and grades of material covered by the specification, together with applications and distinguishing properties.

Type and grade	Applications and distinguishing properties
PF 2A1	General purpose applications
PF 2A2	Similar to type PF 2A1 but with improved electrical properties
PF 1A1	General purpose applications, ammonia free
PF 1A2	General purpose applications, ammonia free, with improved electrical properties
PF 2C1	Heat resistant
PF 2C2	Heat resistant, impact strength higher than type PF 2C1
PF 2C3	Heat resistant, similar to type PF 2C1 but with improved electrical properties
PF 2D1	Impact resistant
PF 2D2	Impact resistant, impact strength higher than type PF 2D1
PF 2D3	Impact resistant, impact strength higher than type PF 2D2
PF 2D4	Impact resistant, impact strength higher than type PF 2D3
PF 2E1	Electrical low loss applications

1.7 It must not be inferred from the above that materials of any particular grade are necessarily unsuitable for applications other than those indicated or that specific materials will be suitable for all applications within the wide descriptions given.

2 REFERENCES

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

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

ISO 120, *Plastics — Phenolformaldehyde mouldings — Determination of free ammonia and ammonium compounds.* [1)]

ISO/R 171, *Plastics — Determination of bulk factor of moulding materials.*

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

ISO/R 179, *Plastics — Determination of the Charpy impact resistance of rigid plastics (Charpy impact flexural test).*

ISO/R 180, *Plastics — Determination of the Izod impact resistance of rigid plastics (Izod impact flexural test).*

ISO 181, *Plastics — Determination of behaviour of rigid plastics in contact with an incandescent bar.* [2)]

ISO 291, *Plastics — Standard atmospheres for conditioning and testing.* [3)]

ISO 295, *Plastics — Compression moulding test specimens of thermosetting materials.*

ISO 308, *Plastics — Phenolic moulding materials — Determination of acetone-soluble matter (resin content of material in the unmoulded state).*

ISO 2577, *Plastics — Thermosetting moulding materials — Determination of shrinkage of compression moulded test specimens in the form of bars.*

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

IEC Publication 112, *Recommended method for determining the comparative tracking index of solid insulating materials under moist conditions.*

IEC Publication 167, *Methods of test for the determination of the insulation resistance of solid insulating materials.*

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 wavelength.*

3 DEFINITIONS

For the purpose of this International Standard the following definitions apply :

3.1 phenolic resin : Synthetic resin produced by reaction of a phenol with formaldehyde. Phenol and cresols are commonly used. These thermosetting resins are either mixtures of novolak and hexamethylenetetramine (two-step PF 2) or resols (one-step PF 1).

3.2 phenolic moulding materials : Thermosetting products based on phenolic resins and fillers used in the manufacture of thermoset moulded articles. Other ingredients, for example colouring matter, may be incorporated.

4 GENERAL REQUIREMENTS

Phenolic moulding materials complying with this specification shall meet the appropriate property requirements shown in the table.

Though it is not included in the table as a specific requirement, flow is a property essential for the satisfactory usage of phenolic moulding material and shall be specified in any contract. The method of test and the flow value shall be agreed between purchaser and supplier.

In addition, for some applications, it may be desirable for information to be made available on other properties of the moulding material, for example curing time and particle size. If this is so, these properties and the methods of test to be used should be agreed between purchaser and supplier.

5 TEST SPECIMENS

Bulk factor shall be measured on the moulding material. The other properties shall be determined on moulded test specimens prepared in accordance with annex A of ISO 295. It is permissible to machine[4)] test specimens from sheet moulded according to the moulding conditions of ISO 295, annex A, as long as it can be shown that the test specimens give results which do not differ significantly from moulded test specimens.

Test specimens to be used for determining the properties given in section B of the table shall be conditioned under prevailing atmospheric conditions as allowed in ISO 291, unless otherwise stated in the method of test or agreed between the interested parties.

1) At present at the stage of draft. (Revision of ISO/R 120-1959.)

2) At present at the stage of draft. (Revision of ISO/R 181-1961.)

3) At present at the stage of draft. (Revision of ISO/R 291-1963.)

4) See ISO 2818.

Tests shall commence not less than 16 h and not more than 72 h after the test specimens have been moulded unless otherwise specified in the test methods.

When the test specimens have been moulded from powder which is preheated or dried, then this fact shall be stated in the test report. The conditions for preheating or drying shall also be given.

6 METHODS OF TEST

6.1 Determination of flexural stress at rupture

See ISO 178. Five test specimens of dimensions $\geqslant$ 80 mm × 10 mm × 4 mm shall be used for the determination.

For both moulded bars and test specimens from material moulded in the form of a plate, the loads shall be applied parallel to the direction of moulding pressure. The testing speed shall be 2 ± 0,2 mm/min.

6.2 Determination of impact strength

6.2.1 *Charpy*

See ISO/R 179. The notched standard bar of dimensions 120 mm × 15 mm × 10 mm shall be used. Five test specimens shall be used for the determination.

For both moulded bars and test specimens machined from material moulded in the form of a plate, the loads shall be applied parallel to the direction of moulding pressure.

6.2.2 *Izod*

See ISO/R 180, method A. Five test specimens of dimensions 63,5 mm × 12,7 mm × 12,7 mm shall be used for the determination.

In the case of test specimens machined from material moulded in the form of a plate, the loads shall be applied perpendicular to the direction of moulding pressure.

6.3 Determination of temperature of deflection under load

See ISO 75, method A. Two test specimens of dimensions $\geqslant$ 110 mm × 10 mm × 4 mm shall be used for the determination.

6.4 Determination of incandescence resistance

Three specimens 10 mm × 4 mm × 120 mm shall be used for the determination. Except for the following details, the test shall be carried out in accordance with ISO 181 :

After 3 min turn the ignition bar holder away from the specimen and note whether there is any visible flame on the specimen during the next 30 s.

6.5 Determination of insulation resistance

See IEC Publication 167. The test specimen shall be in the form of a flat plate moulded to a thickness of 3,0 ± 0,25 mm. The taper pin electrodes shall be used. Before carrying out the test, the test specimen shall be conditioned (without electrodes) in an oven at 50 ± 2 °C for 24 ± 1 h and then cooled to room temperature in a desiccator. It shall then be immersed in distilled or de-ionized water maintained at 23 ± 2 °C for 24 ± 1 h. Before the specimen is tested, the surface water shall be removed with blotting paper or filter paper or with a clean absorbent cloth, and the electrodes then fitted. Measurement of insulation resistance shall be made within 5 min after the end of the immersion. At least two test specimens shall be used for the determination.

6.6 Determination of electric strength at power frequencies

See IEC Publication 243. At least two[1] test specimens shall be used for the determination. Each shall be 3,0 ± 0,25 mm thick and not less than 100 mm in diameter. Each test specimen shall be immersed in oil at a temperature of 90 ± 2 °C for 15 to 20 min before the test and during the test. The 20 s step-by-step method shall be used.

6.7 Determination of dielectric dissipation factor

See IEC Publication 250. The test frequency shall be 1 MHz. Two test specimens shall be used for the determination.

6.8 Determination of tracking resistance under moist conditions

See IEC Publication 112, Proof test. The voltage applied shall be the proof voltage given in the table of property requirements. The material shall not track before 51 drops of electrolyte have fallen.

6.9 Determination of free ammonia and ammonium compounds

See ISO 120. The powdered test portion shall be prepared from a 3 mm or 4 mm thick moulded plate.

6.10 Determination of water absorption

See ISO/R 62, procedure A. Two test specimens 50 mm in diameter and 3 mm thick shall be used for the determination.

NOTE – As an alternative, when agreed between purchaser and supplier, test specimens 50 mm × 50 mm cut from 4 mm thick moulded plates may be used. If this alternative type of test specimen is used, the requirements shall also be the subject of agreement between purchaser and supplier.

6.11 Determination of moulding shrinkage

See ISO 2577. Two test specimens of dimensions 120 mm × 15 mm × 10 mm shall be used for the determination.

1) It may be necessary to measure the short time value on an additional test specimen in order to determine the initial voltage to be applied.

TABLE — **Property requirements for phenolic moulding materials**

Property	Method of test	Units	Max. or Min.	Type and Grade											
				Type A				Type C			Type D				Type E
				PF 2A1	PF 2A2	PF 1A1	PF 1A2	PF 2C1	PF 2C2	PF 2C3	PF 2D1	PF 2D2	PF 2D3	PF 2D4	PF 2E1
A *Properties measured on moulding materials*															
Bulk factor	ISO/R 171		max.	3,0	3,0	3,0	3,0	4	6	4	5	6	8	15	3,5
Flow	See note 2			To be agreed between purchaser and supplier											
B *Properties measured on test pieces*															
Flexual stress at rupture	ISO 178	MPa	min.	70	70	60	60	50	50	50	55	55	55	55	50
Impact strength (notched)															
– Charpy (see note 3)	ISO/R 179	kJ/m^2	min.	1,5	1,5	1,3	1,3	2,0	5,0	2,0	2,5	3,5	6,0	12,0	1,5
– Izod (see note 3)	ISO/R 180	J/m of notch	min.	13	13	13	13	20	50	20	25	35	60	120	15
Temperature of deflection under load	ISO 75, method A	°C	min.	140	140	120	110	155	160	155	135	140	140	140	160
Incandescence resistance	ISO 181 See note 4		min.	–	–	–	–	See note 5			–	–	–	–	–
Insulation resistance	IEC 167	ohm	min.	–	10^8	–	10^{10}	–	–	10^8	–	–	–	–	10^{12}
Electric strength at 90 °C	IEC 243 in oil, 20 s step method	MV/m	min.	–	3,5	–	–	–	–	2,0	–	–	–	–	5,8
Dielectric dissipation factor (tan δ) at 1 MHz	IEC 250		max.	–	0,1	–	–	–	–	–	–	–	–	–	0,030
Tracking resistance	IEC 112	V	min.	–	–	–	–	–	–	175	–	–	–	–	175
Free ammonia	ISO 120	%	max.	–	–	0,02	0,02	–	–	–	–	–	–	–	–
Water absorption	ISO/R 62, method A See note 6	mg	max.	60	60	60	60	40	50	40	80	150	150	150	20
Moulding shrinkage	ISO 2577	%	max.	To be agreed between purchaser and supplier											

NOTES

1 The requirements apply to the mean result for the number of test specimens specified for each method.

2 The method of test for flow should be agreed between purchaser and supplier. Flow may also depend upon resin content. For the determination of resin content of two-step materials see ISO 308.

3 Only one impact test method to be used, as agreed between purchaser and supplier.

4 As modified by sub-clause 6.4.

5 There shall be no visible flame from any specimen after removing the igniting bar.

6 See note in sub-clause 6.10 regarding the use of an alternative type of test specimen.