INTERNATIONAL STANDARD

ISO 8873-1

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Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation —

Part 1: Material specifications

Plastiques alvéolaires rigides — Mousse de polyuréthanne projetée pour l'isolation thermique —

Partie 1: Spécifications des matériaux

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 8873-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

This first edition of ISO 8873-1, together with ISO 8873-2 and ISO 8873-3, cancels and replaces ISO 8873:1987, which has been technically revised.

ISO 8873 consists of the following parts, under the general title *Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation*:

— *Part 1: Material specifications*

— *Part 2: Application*

— *Part 3: Test methods*

Introduction

ISO 8873 defines the requirements for rigid cellular plastic spray polyurethane foam when used as a thermal insulation in buildings and non-buildings.

This part of ISO 8873 specifies requirements for the physical properties of rigid cellular plastic spray polyurethane foam and lists the test methods to be used.

The designer has the responsibility for confirming that the physical properties provided by material manufactured to this part of ISO 8873 will conform to the requirements for a specific application.

Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation —

Part 1:
Material specifications

WARNING — Persons using this document should be familiar with normal laboratory practice, if applicable. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory requirements.

1 Scope

This part of ISO 8873 specifies minimum requirements and test methods for spray-applied polyurethane rigid cellular plastic, used as a thermal insulation for both building, whether applied on a building site or in a prefabrication (manufacturing) facility, and non-building applications. The material is also known as *in-situ* thermal insulation.

The spray-applied polyurethane rigid cellular plastic thermal insulation is not to be used when the continuous service temperature of the substrate is outside the range of −60 °C to +80 °C.

The test methods used to determine the material properties provide a means of comparing different cellular plastic thermal insulations. They are intended for use in specifications, product evaluations and quality control. They are not intended to predict end-use product performance.

Spray-applied polyurethane rigid cellular plastics are to be applied (installed) in accordance with the manufacturer's instructions and the requirements of ISO 8873-2. Applications, requirements for applications and limitations of use are included in ISO 8873-2.

2 Normative references

The following referenced documents are indispensable for the application 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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 844, *Rigid cellular plastics — Determination of compression properties*

ISO 845, *Cellular plastics and rubbers — Determination of apparent density*

ISO 1663, *Rigid cellular plastics — Determination of water vapour transmission properties*

ISO 1926, *Rigid cellular plastics — Determination of tensile properties*

ISO 2796, *Cellular plastics, rigid — Test for dimensional stability*

ISO 2896, *Rigid cellular plastics — Determination of water absorption*

ISO 4590, *Rigid cellular plastics — Determination of the volume percentage of open cells and of closed cells*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 8302, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus*

ISO 8873-2:—[1)], *Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation — Part 2: Application*

ISO 8873-3:—[2)], *Rigid cellular plastics — Spray-applied polyurethane foam for thermal insulation — Part 3: Test methods*

ISO 10456, *Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values*

ISO 11561, *Ageing of thermal insulation materials — Determination of the long-term change in thermal resistance of closed-cell plastics (accelerated laboratory test methods)*

ISO/IEC 17024, *Conformity assessment — General requirements for bodies operating certification of persons*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
authority having jurisdiction
officer or officers having authority, under appropriate regulatory instruments, to exercise enforcement

3.2
certification organization
impartial body possessing the necessary competence and reliability to operate a certification system in accordance with ISO/IEC 17024, in which the interests of all parties concerned with the functioning of the system are represented

3.3
equipment manufacturer
manufacturer of equipment designed for spray-application of rigid polyurethane cellular plastic thermal insulation

3.4
***in-situ* thermal insulation**
thermal insulation product produced or taking its final form at the site of application and which achieves its properties after installation

3.5
spray-applied polyurethane foam
rigid cellular plastic material with substantially closed cell structure based on polyurethanes, which is foamed *in-situ* by the catalysed reaction of polyisocyanates and polyhydroxyl compounds, expanded with blowing agents

3.6
spray polyurethane foam contractor
individual, organization or corporation who is responsible for all requirements and obligations for the installation of the product

1) To be published.

2) To be published.

3.7
spray polyurethane foam installer
individual or worker who applies the chemical components by mixing and spraying them to form the rigid cellular plastic spray polyurethane foam product

NOTE The installer is responsible for the actual installation and site requirements identified by the manufacturer and/or ISO 8873-2 for application of the product. The installer shall be trained, and qualified as having demonstrated the required knowledge for proper application of the product by a Certification Organization (CO). The installer shall follow the requirements for installation and the obligations for installers identified by the manufacturer and ISO 8873-2.

3.8
spray polyurethane foam system manufacturer
manufacturer/supplier of the liquid chemical components, polyisocyanates and a polyhydroxyl blends containing also flame retardants, blowing agent and catalysts (system), which are designed to be mixed and sprayed to form rigid polyurethane foam insulation material *in situ*

4 Requirements

4.1 General requirements

Rigid cellular plastic spray-applied polyurethane foam thermal insulation shall be applied by a spray polyurethane foam contractor using a spray polyurethane foam installer in accordance with ISO 8873-2 and the instructions given by the chemical manufacturer.

When applied, the polyurethane rigid cellular plastic thermal insulation shall not present a health hazard to the potential occupants nor shall the cured insulation have any residual odour.

Special applications may require properties other than, or in addition to, those specified in this part of ISO 8873. These properties, when agreed upon by the interested parties, may be added to the requirements of this specification.

When stored in accordance with the chemical manufacturer's instructions, applied in accordance with ISO 8873-2, and within the shelf life of the chemicals as declared by the manufacturer, the chemical components shall produce an insulation that meets the requirements of this part of ISO 8873.

4.2 Categories

Category IA: Suitable for non-load-bearing insulations that may not be exposed to weather, such as wall insulations, interior roof insulations and similar applications where the insulation is only required to be self-supporting, expanded with fluorocarbons and producing a predominantly closed-cell product.

Category IB: Suitable for non-load-bearing insulations that may not be exposed to weather, such as wall insulations, interior roof insulations and similar applications where the insulation is only required to be self-supporting, expanded with carbon dioxide and producing a predominantly semi-closed-cell product.

Category IC: Suitable for non-load-bearing insulations that may not be exposed to weather, such as wall insulations, interior roof insulations and similar applications where the insulation is only required to be self-supporting, expanded with carbon dioxide and producing a predominantly open-cell product.

Category IIA: Suitable for limited-load-bearing insulations that may or may not be exposed to weather, intended for surfaces carrying foot-traffic from maintenance personnel only, such as overdeck insulations or similar applications where elevated temperatures may be encountered and when compressive creep resistance is required, expanded with fluorocarbons and producing a predominantly closed-cell product.

Category IIB: Suitable for limited-load-bearing insulations that may or may not be exposed to weather, intended for surfaces carrying foot-traffic from maintenance personnel only, such as overdeck insulations or similar applications where elevated temperatures may be encountered and when compressive creep resistance is required, expanded with carbon dioxide and producing a predominantly closed-cell product.

5 Sampling

5.1 General

Random sampling shall be carried out by a third-party company according to provisions stipulated by the certification agency, purchaser or as described in this product specification.

Sampling shall be done by a third-party organization or as agreed to between the manufacturer and the purchaser.

For testing purposes, select at random an unopened container of each component material and store within the temperature range of 13 °C to 21 °C (or as specified on the containers) until a period of two weeks before the end of shelf life as declared by the manufacturer prior to the preparation of the sample panels. Unless otherwise specified, the frequency of testing and the number of sample panels shall be left to the discretion of the inspection authority.

5.2 Preparation of sample panels

Samples of rigid polyurethane cellular plastic thermal insulation panels that are representative of the end product shall be prepared by a spray polyurethane foam installer (as specified in 4.1). Specimens used for testing shall be cut from these sample panels using a band saw or similar equipment.

Unless otherwise specified in the test method, the sample panels shall be made by spraying the product onto a 16-mm thick polyethylene board (or other boards which, with the use of a release agent, will allow the skin of the material to be left intact) to achieve the manufacturer's declared foam density. All testing shall be conducted with specimens that all have the same density. A single batch (lot) of material shall be used to produce an entire set of sample panels required to produce individual specimens in the size required by the testing laboratory to conduct all of the tests. The finished sample panels shall have a nominal thickness of 60 mm [containing one external skin and a minimum of one internal skin but no more than three internal skins (pass lines)]. The ambient temperature in the area where the sample panels are produced and the substrate temperature shall be (23 ± 5) °C and the ambient relative humidity shall not exceed 80 %, unless otherwise specified and so reported. The size of the foam sample panels shall be a minimum of 1 m × 1 m.

The manufacturer shall use a single batch (lot) of material, which represents the material specification requirements used in their Quality Control Programme. All tests for the physical properties shall be carried out using foam specimens cut from the same sample panels, sprayed using a single batch (lot), which has been formulated and installed in order to represent the installed foam density required by the manufacturer.

5.3 Conditioning of sample panels

Unless otherwise specified, sample panels (with the polyethylene, or other, board still attached to the foam) shall be conditioned in accordance with ISO 291 for 48 h at (23 ± 2) °C and (50 ± 5) % RH, or (23 ± 5) °C and (50^{+20}_{-10}) % RH prior to cutting and testing for physical properties.

5.4 Preparation of specimens

Specimens shall be cut from the sample panels described in 5.2 and conditioned in accordance with 5.3. All specimens cut from the sample panels shall have been produced from the same batch (lot) of material for all of the testing. Unless specified otherwise, specimens shall be 50 mm thick and shall contain one pass line (internal skin) within the specimen for all specimens required for testing purposes. All specimens shall be obtained from the conditioned sample panels by removing the foam specimen from the polyethylene (or other) board and cutting the specimen to the size required by the testing equipment. The one external skin [opposite to the polyethylene (or other) board)] shall be removed to produce a flat specimen. The skin that was produced by the polyethylene (or other) board is to be left intact.

The testing laboratory shall check the flatness of the specimens to determine acceptability before using them. All measurements shall be determined in the “flat” position.

6 Test methods

6.1 Air permeance

Determine the air permeance in accordance with ISO 8873-3 on a 1 m × 1 m specimen. A minimum of five specimens should be tested over a range of six pressure differences from 50 Pa to 500 Pa. The air leakage rate at 75 Pa shall be taken from the linear regression line ($r^2 = 0{,}99$) of the 30 data points. The specimen for testing shall be prepared in accordance with Clause 5 and to the size outlined in ISO 8873-3.

6.2 Apparent core density

Determine the apparent core density in accordance with ISO 845 using at least five core specimens. The specimen used for apparent core density shall have all exterior skins removed and shall not contain more than three internal pass lines.

6.3 Compressive strength

Determine the compressive strength in accordance with ISO 844, using five core specimens measuring (150 × 150 × 50) mm each.

6.4 Dimensional stability

Determine the dimensional stability in accordance with ISO 2796, except that the conditioning time shall be 14 d at (23 ± 2) °C and (50 ± 5) % RH. Measure the dimensional changes after the 50-mm-thick specimens have been exposed to the following conditions (use at least three specimens for each exposure condition):

— 28 d at (-20 ± 3) °C, ambient humidity;

— 28 d at (80 ± 3) °C, ambient humidity;

— 28 d at (70 ± 3) °C, (97 ± 3) % RH.

Report the percentage change for all three dimensions obtained for each exposure. Express the results as a "plus %" when there has been expansion and as a "minus %" when there has been shrinkage.

6.5 Surface burning characteristics

Determine the surface burning characteristics of the insulation in accordance with requirements of the authority having jurisdiction.

6.6 Open-cell content: Volume

Determine the open-cell content volume as the average of the measurements according to ISO 4590 using three 25-mm^3 core specimens.

6.7 Initial thermal resistance

Determine the thermal resistance for a 50-mm specimen in accordance with ISO 8301 or ISO 8302 at a standard mean temperature of 24 °C and a temperature differential of (23 ± 5) °C. Optionally, thermal resistance may be determined at other additional designated mean temperatures (−4 °C, 4 °C, 44 °C). In cases of dispute, use ISO 8301. Report the density of the tested specimens.

For the thermal resistance per unit thickness, determine the thermal resistance on at least three specimens 50 mm thick after 14 days at (23 ± 2) °C. Report the density of the tested specimens.

The design and declared thermal resistance shall be calculated in accordance with ISO 10456.

6.8 Long-term thermal resistance (LTTR)

Determine the long-term thermal resistance (LTTR) in accordance with ISO 11561.

When measuring the thermal resistance, the mean temperature shall have a temperature difference across the specimen of (23 ± 5) °C.

This thermal resistance value shall be the design thermal resistance value for the purposes of energy calculations.

The LTTR value depends on the material thickness. The LTTR shall be determined and reported for 25-mm, 50-mm and 75-mm products. From the above data points, LTTR values can be determined for products from 12 mm to 100 mm. Other thicknesses may be tested and reported. The value determined shall meet the minimum requirement listed in Table 1.

Table 1 — Physical properties

Property	Unit	Requirements					Test method
		Category I			Category II		
		A	B	C	A	B	
Air permeance at 75 Pa	l/(s·m^2)	0,02	Declared		0,02	0,02	ISO 8873-3
Apparent core density	kg/m^3	Declared					ISO 845
Compressive strength (min.)	kPa	100	80	—	170	170	ISO 844
Dimensional stability at							
−20 °C (max.)	%	± 1	± 1	—	± 1	± 1	ISO 2796
80 °C (max.)	%	± 5	± 5	—	± 5	± 5	ISO 2796
70 °C, (97 ± 3) % RH	%	± 10	± 10	—	± 10	± 10	ISO 2796
Surface burning characteristics: flame spread		Declared					Determined by authority having jurisdiction
Open-cell content (max.)	%	15	60	—	15	15	ISO 4590
Initial thermal resistance: 50-mm specimen 14 d at (23 ± 2) °C	m^2·K/W	2,27	1,56	1,25	2,27	1,56	ISO 8301 or ISO 8302
Long-term thermal resistance (LTTR) for a 50-mm-thick specimen	m^2·K/W	1,92	1,47	1,25	1,92	1,47	ISO 11561
Tensile strength	kPa	120	100	—	200	200	ISO 1926
Tensile adhesion	—	Cohesive failure in the foam					ISO 8873-1
Volatile organic emissions	—	Declared					Determined by authority having jurisdiction
Water absorption (max.)	% (by volume)	—	—	—	4	4	ISO 2896
Water vapour permeability	ng/(Pa·s·m)	4,5	9,0	—	4,5	4,5	ISO 1663

NOTE The test methods used to determine the material properties provide a means of comparing different cellular plastic thermal insulations. They are intended for use in specifications, product evaluations and quality control. They are not intended to predict end-use product performance.

6.9 Tensile strength

Determine the tensile adhesive strength in accordance with ISO 1926, using a minimum of five specimens perpendicular to the flat insulation surface.