INTERNATIONAL STANDARD

ISO 4898

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Rigid cellular plastics — Thermal insulation products for buildings — Specifications

Plastiques alvéolaires rigides — Produits d'isolation thermique pour bâtiments — Spécifications

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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 4898 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

This fourth edition cancels and replaces the third edition (ISO 4898:2006), of which it constitutes a minor revision. The main changes are as follows:

— the property “long-term thermal resistance” has been deleted from Table 3;

— also in Table 3, the minimum period for measurement of the initial thermal conductivity has been changed from 180 days to 28 days, as it is in the subsequent tables;

— the property “bending load at break” has been included in Table 5, as in the other tables;

— Table 6 has been corrected so that footnote “b” no longer applies to the property “density” in the first line of the table.

Rigid cellular plastics — Thermal insulation products for buildings — Specifications

1 Scope

This International Standard specifies requirements and methods of testing for four categories of rigid cellular plastics thermal-insulation products for buildings. It covers rigid cellular plastics in the form of flat or profiled boards, with or without natural skins. They may also be faced or laminated with foil, plastic or metal films or sheets, mineral coatings, paper, cardboard or other materials.

This International Standard is not applicable to materials used for the thermal insulation of pipes and vessels, for impact sound absorption or for acoustical insulation.

This International Standard covers the following cellular materials used in the thermal insulation of buildings:

PF based on phenolic polymer;

EPS based on expanded polystyrene;

XPS based on extruded polystyrene;

PUR based on polyurethane.

The limiting quality values in this International Standard are for use only in the specification of materials between purchaser and supplier, and are not intended to be used for design purposes.

Additional requirements for special applications may be added to those specified in this International Standard by agreement between purchaser and supplier.

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 472, *Plastics — Vocabulary*

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

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

ISO 1040, *Building construction — Modular coordination — Multimodules for horizontal coordinating dimensions*

ISO 1209-1, *Rigid cellular plastics — Determination of flexural properties — Part 1: Basic bending test*

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

ISO 1923, *Cellular plastics and rubbers — Determination of linear dimensions*

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

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

ISO 7616, *Cellular plastics, rigid — Determination of compressive creep under specified load and temperature conditions*

ISO 7850, *Cellular plastics, rigid — Determination of compressive creep*

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 11561:1999, *Ageing of thermal insulating materials — Determination of the long-term change in thermal resistance of closed-cell plastics (accelerated laboratory test methods)*

ISO 12576-1:2001, *Thermal insulation — Insulating materials and products for buildings — Conformity control systems — Part 1: Factory-made products*

3 Terms and definitions

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

3.1
EPS
rigid cellular plastics insulation material manufactured by moulding beads of expandable polystyrene or one of its copolymers and that has a substantially closed-cell structure, filled with air

[ISO 9229:2007]

3.2
XPS
rigid cellular plastics insulation material expanded and extruded with or without a skin from polystyrene or one of its copolymers and that has a closed-cell structure

[ISO 9229:2007]

3.3
PUR
rigid cellular plastic insulation material with a substantially closed-cell structure based on polyurethane or urethane/isocyanurate polymers

NOTE For definitions of **polyisocyanurate plastic**, **polyurethane** and **urethane plastic**, see ISO 472.

3.4
PF
rigid cellular insulation foam, the polymer structure of which is made primarily from the polycondensation of phenol, its homologues and/or derivatives with aldehydes or ketones

[ISO 9229:2007]

NOTE PF used for thermal-insulation purposes has a cellular structure consisting substantially of closed cells (subcategory A) or with a higher content of open cells (subcategory B) which affects the thermal conductivity.

4 Sizes and dimensional-tolerance requirements

4.1 Board materials shall be supplied in dimensions agreed between purchaser and supplier or in accordance with ISO 1040. Boards shall be flat.

4.2 Dimensional tolerances for length, width and squareness shall conform to the requirements specified in Table 1.

Table 1 — Tolerances for dimensions and squareness

Length or width mm	**Tolerance on length or width** (see Note 1) mm	**Squareness tolerances based on differences in diagonal measurements** (see Notes 2 and 3) mm
< 1 000	± 8	5
⩾ 1 000	± 10	5
NOTE 1 If more restrictive tolerances are required, these shall be agreed between purchaser and supplier.		
NOTE 2 Tolerance categories for diagonal measurements are based on the board length (not width).		
NOTE 3 Squareness may also be determined by equivalent methods such as the use of a rectangular pattern.		

4.3 Dimensional tolerances for thickness shall conform to the requirements specified in Table 2.

Table 2 — Tolerances for thickness

Thickness mm	**Tolerance** (see Note 1) mm
less than 50	± 2
50 to 75 (incl.)	± 3
> 75 to 100 (incl.)	± 3 (see Note 2)
> 100	To be agreed between purchaser and supplier
NOTE 1 If more restrictive tolerances are required, these shall be agreed between purchaser and supplier.	
NOTE 2 For EPS with natural skins, the thickness tolerance for this thickness category shall be ± 4 mm.	

5 Physical-property requirements

5.1 Categories

Physical-property requirements are organized into product categories to meet purchaser and supplier needs over a range of end-use applications.

Category I Suitable for non-load-bearing applications such as wall and cavity insulation, vented roofs, cavity wall insulation and similar applications.

Category II Suitable for limited load-bearing applications such as in built-up roofs, under floors and comparable applications, where elevated temperatures may be encountered and where compressive creep resistance is required. Products in this category may also be used for applications listed in category I.

Categories III and IV Suitable for load-bearing applications such as in parking decks, floors of cold-storage areas and comparable applications requiring a higher level of compressive strength and compressive creep resistance. Products in these categories may also be used for applications listed in categories I and II.

5.2 Subcategories

Product property categories I to III can be further divided into subcategories (A, B, C) on the basis of thermal-conductivity values. All thermal-conductivity specification values given for the subcategories in the tables are maximum values.

Thermal-conductivity values given in the tables shall be used only as limiting quality values for specification of materials between purchaser and supplier. They shall not be used for design purposes.

5.3 Limiting quality values

EPS materials shall conform to the limiting quality values for physical properties as specified in Table 3.

XPS materials shall conform to the limiting quality values for physical properties as specified in Table 4.

PUR materials shall conform to the limiting quality values for physical properties as specified in Table 5.

PF materials shall conform to the limiting quality values for physical properties as specified in Table 6.

5.4 Burning characteristics

It is recognized that there is a need to consider the burning characteristics of these materials in their intended application. Therefore, until such time as International Standards become available, individual national practice should be followed.

NOTE Due to compositional and processing parameters, some PF materials may exhibit smouldering combustion (punking).

6 Sampling

6.1 For density determinations, ten full-size boards are required.

6.2 For all other physical-property determinations and for dimensional measurements, at least three full-size boards are required.

7 Ageing and conditioning

7.1 Ageing

7.1.1 There is no requirement to age materials faced with impermeable, hole-free facings.

NOTE For example, metal coverings of about 50 µm thickness have been found to meet this facing requirement.

7.1.2 All materials without impermeable, hole-free facings shall be aged under ambient conditions for a minimum of 28 days from the date of manufacture. Thermal-conductivity test specimens shall be aged with all surfaces exposed to the ambient air.

NOTE ISO 11561:1999 has, in Annex A, an analytical model for calculating design values for thermal conductivity after ageing, based on a so-called "slicing and scaling" technique, and, in Annex B, a method for determining the long-term thermal resistance of products with impermeable facings.

7.2 Conditioning

Prior to dimensional measurements and physical-property testing, the test specimens shall be conditioned, with all surfaces exposed, for a minimum of 48 h at (23 ± 5) °C and 50^{+20}_{-10} % relative humidity. This 48 h conditioning period may be incorporated as the final two days of the 28-day ageing period.

8 Test methods

8.1 Linear dimensions

The linear dimensions shall be measured in accordance with ISO 1923 for each of three boards. If the material has a surface facing, lamination or natural skin, the dimensions shall be determined without removing them.

A minimum of five measurements shall be made for each dimension. Each single value shall be within the tolerances specified in 4.2 and 4.3.

8.2 Density

Density measurement is optional for all materials in countries where a system of class identification has been established.

Density shall be determined in accordance with ISO 845 on each of ten full-size boards and reported as the average of the ten specimens. The average density of the ten specimens shall be equal to or greater than the minimum required and no single specimen shall be less than 90 % of the minimum requirement.

When the natural skin of the material forms an integral part of the product in its end use, the surface skin shall not be removed prior to the determination of the density. For those materials with surface facing, lamination or coating, the density shall be determined for the core material after removing such facing, lamination or coating.

8.3 Compressive strength

The compressive strength or the compressive stress at 10 % deformation or yield, whichever occurs first, shall be determined in accordance with ISO 844. Specimens shall be tested with natural skin integral to the final product, surface facing, lamination or coating, unless surface irregularities require removal of such surfaces for uniform loading.

The compressive strength shall be measured in the direction normal to the surface of the board.

8.4 Thermal conductivity

8.4.1 Initial thermal conductivity

The initial thermal conductivity shall be determined in accordance with ISO 8301 or ISO 8302 at a mean temperature of either 23 °C or 10 °C. Thermal-conductivity values measured at one of these mean temperatures may be used to calculate the mean value for the other temperature on the basis of a documented thermal conductivity versus mean temperature relationship. In cases of dispute, the thermal conductivity shall be determined at the mean temperature for which the value is reported.

8.4.2 Long-term thermal resistance

All cellular plastic insulation manufactured with the intent to retain a blowing agent, other than air, for a period longer than 180 days shall be tested for long-term thermal resistance in accordance with ISO 11561. When measuring the thermal resistance, the temperature difference across the specimen shall be (23 ± 5) °C.

8.5 Dimensional stability/compressive creep properties at elevated temperature

8.5.1 Dimensional stability shall be determined at 70 °C for 48 h in accordance with ISO 2796, except that the thickness of the test specimen shall be equal to the thickness of the board as sold. Surface skins or facings shall not be removed.

8.5.2 Compressive creep after 48 h at 20 kPa and 80 °C shall be determined in accordance with ISO 7616 or ISO 7850, except that the specimen dimensions shall be (50 ± 1) mm × (50 ± 1) mm × the thickness of the board as sold. Surface skins or facings shall not be removed. If the product thickness is greater than 50 mm, the specimen shall be a cube with the side dimensions equal to the thickness.

The specimens shall be subjected to a load of 20 kPa in an atmosphere conforming to the requirements of ISO 291. After 48 h, the test specimens shall be subjected to a temperature of 80 °C under the same load for an additional 48 h. The differences in compressive deformation between each of the two time periods shall be reported.

8.5.3 Compressive creep after 7 days at 40 kPa and 70 °C shall be determined in accordance with ISO 7616 or ISO 7850, except that the specimen dimensions shall be (50 ± 1) mm × (50 ± 1) mm × the thickness of the board as sold. Surface skins or facings shall not be removed. If the product thickness is greater than 50 mm, the specimen shall be a cube with the side dimensions equal to the thickness. Except for the differences in load and temperature, the procedure is the same as in 8.5.2.

8.6 Water vapour permeability

Water vapour permeability shall be determined in accordance with ISO 1663 under one of the following sets of test conditions:

a) 38 °C/0 % to 88,5 % RH;

b) 23 °C/0 % to 50 % RH.

8.7 Water absorption

Water absorption shall be determined in accordance with ISO 2896.

Water absorption measurement is required when direct contact with water is anticipated in the end-use application, e.g. inverted roof insulation and comparable applications.

8.8 Bending load at break

Bending load at break shall be determined in accordance with ISO 1209-1, except that the test specimen shall be 250 mm × 100 mm × 20 mm thick, the distance between the specimen supports shall be 200 mm and the speed of the loading edge shall be 50 mm/min.

9 Conformity control

For the purposes of sampling and conformity control, the procedures described in ISO 12576-1 shall be applied except as amended for the purposes of this International Standard in Annex A.

10 Labelling and marking of products

Rigid cellular materials used in the thermal insulation of buildings shall be delivered with the following information marked on the product or included in or on the package:

a) the product trade name and manufacturer's name;

b) the production code, including the lot number and location of manufacturing of the finished product;

c) the type of product and category, for example EPS cat. II B;

d) the type of facing, if any;

e) the nominal length, width and thickness of the boards and the number of boards in each package;

f) additional marking as required by national regulations of countries where the product is to be used, e.g. declared and/or design λ- or R-values, burning behaviour and health/safety information;

g) a reference to this International Standard.

11 Reporting requirements

The test report summary shall include the following information:

a) a reference to this International Standard;

b) the product trade name and the supplier, lot number and date of manufacture;

c) the type of product (EPS, XPS, PUR, PF) and other description such as the presence and type of facings;

d) the nominal size of product sold;

e) the physical-property requirement category and subcategory against which the product is being tested;

f) the test conditions used if a choice of conditions is permitted (such as with thermal conductivity and water vapour permeability);

g) any deviation from or additions to the requirements of this International Standard, as agreed upon between purchaser and supplier;

h) a complete listing of all test results and a comparison with the requirements of this International Standard.

Table 3 — Required properties of EPS used for thermal insulation of buildings

Property	Unit	Category (see 5.1) and subcategory (see 5.2)							Test method
		I	II		III			IV	
			A	B	A	B	C		
Density (min.)[a]	kg/m^3	15	20	20	30	30	30	30	ISO 845
Compressive strength or compressive stress at 10 % deformation or yield (min.)	kPa	50	100	100	150	150	150	250	ISO 844
Initial thermal conductivity (max.)									
10 °C mean/28 days min.	mW/(m·K)	37	34	37	28	32	37	25	ISO 8301 or ISO 8302
or									
23 °C mean/28 days min.	mW/(m·K)	39	36	39	29	34	39	26	
Dimensional change after 48 h at 70 °C (max.)	%	5	5	5	5	5	5	5	ISO 2796 as modified in 8.5.1
Compressive creep (max.) after 48 h at 80 °C under 20 kPa load	%	—	5	5	—	—	—	—	ISO 7616 or ISO 7850 as modified in 8.5.2
Compressive creep (max.) after 7 days at 70 °C under 40 kPa load	%	—	—	—	5	5	5	5	ISO 7616 or ISO 7850 as modified in 8.5.3
Water vapour permeability[b]									
23 °C/0 % to 50 % RH	ng/(Pa·s·m)	9,5 to 3,5	4,5 to 0,5		2,0 to 0,5		4,5 to 1,0	4,5 to 1,0	ISO 1663
Water absorption (max.)	% by volume	6	4	4	2	2	2	2	ISO 2896
Bending load at break (min.)	N	15	25	25	35	35	35	35	ISO 1209-1 as modified in 8.8

[a] Density is optional in a country that has established a system of class identification.

[b] A specific limiting value (maximum or minimum, depending on the application) may be selected by agreement between purchaser and supplier.

Table 4 — Properties of XPS used for thermal insulation of buildings

Property	Unit	Category (see 5.1) and subcategory (see 5.2)						Test method
		I	II		III			
			A	B	A	B	C	
Density (min.)[a]	kg/m^3	25	30	30	35	40	45	ISO 845
Compressive strength or compressive stress at 10 % deformation or yield (min.)	kPa	150	250	250	350	450	550	ISO 844
Initial thermal conductivity (max.)								
10 °C mean/28 days min.	mW/(m·K)	25	25	25	25	25	25	ISO 8301 or ISO 8302
or								
23 °C mean/28 days min.	mW/(m·K)	26	26	26	26	26	26	
Long-term thermal resistance (min.)	(m^2·K)/W	As declared by manufacturer						ISO 11561
Dimensional change after 48 h at 70 °C (max.)	%	5	5	5	5	5	5	ISO 2796 as modified in 8.5.1
Compressive creep (max.) after 48 h at 80 °C under 20 kPa load	%	—	—	—	—	—	—	ISO 7616 or ISO 7850 as modified in 8.5.2
Compressive creep (max.) after 7 days at 70 °C under 40 kPa load	%	5	5	5	5	5	5	ISO 7616 or ISO 7850 as modified in 8.5.3
Water vapour permeability[b]								
23 °C/0 % to 50 % RH	ng/(Pa·s·m)	2,0 to 1,5	2,0 to 1,5		2,0 to 1,5		2,0 to 1,5	ISO 1663
Water absorption (max.)	% by volume	1	1	1	1	1	1	ISO 2896
Bending load at break (min.)	N	35	35	35	35	35	35	ISO 1209-1 as modified in 8.8

[a] Density is optional in a country that has established a system of class identification.

[b] A specific limiting value (maximum or minimum, depending on the application) may be selected by agreement between purchaser and supplier.

Table 5 — Properties of PUR used for thermal insulation of buildings

Properties	Unit	Category (see 5.1) and subcategory (see 5.2)						Test method
		I		II		III		
		A	B	A	B	A	B	
Density (min.) [a]	kg/m^3	25	25	30	30	30	30	ISO 845
Compressive strength or compressive stress at 10 % deformation or yield (min.)	kPa	80	80	100	100	150	150	ISO 844
Initial thermal conductivity (max.)								
10 °C mean/28 days min.	mW/(m·K)	—	—	22	—	22	—	ISO 8301 or ISO 8302
or								
23 °C mean/28 days min.	mW/m·K	24	29	24	29	24	29	
Long-term thermal resistance (min.)	(m^2·K)/W	As declared by manufacturer						ISO 11561
Dimensional change after 48 h at 70 °C (max.)	%	5	5	5	5	5	5	ISO 2796 as modified in 8.5.1
Compressive creep (max.) after 48 h at 80 °C under 20 kPa load	%	—	—	5	5	—	—	ISO 7616 or ISO 7850 as modified in 8.5.2
Compressive creep (max.) after 7 days at 70 °C under 40 kPa load	%	—	—	—	—	5	5	ISO 7616 or ISO 7850 as modified in 8.5.3
Water vapour permeability								
23 °C/0 % to 50 % RH	ng/(Pa·s·m)	6,5		6,5		6,5		ISO 1663
Water absorption (max.)	% by volume	4	4	4	4	3	3	ISO 2896
Bending load at break (min.)	N	15	15	25	25	35	35	ISO 1209-1 as modified in 8.8

[a] Density is optional in a country that has established a system of class identification.

Table 6 — Properties of PF used for thermal insulation of buildings

Properties	Unit	Category (see 5.1) and subcategory (see 5.2)					Test method
		I		II		III	
		A	B	A	B	A	
Density (min.) [a]	kg/m^3	30	30	40	40	60	ISO 845
Compressive strength or compressive stress at 10 % deformation or yield (min.)	kPa	60	60	100	100	250	ISO 844
Initial thermal conductivity (max.)							
10 °C mean/28 days min.	mW/(m·K)	20	35	20	35	37	ISO 8301 or ISO 8302
or							
23 °C mean/28 days min.	mW/m·K	22	37	22	37	39	
Long-term thermal resistance (min.)	(m^2·K)/W	As declared by manufacturer					ISO 11561
Dimensional change after 48 h at 70 °C (max.)	%	2	2	2	2	2	ISO 2796 as modified in 8.5.1
Compressive creep (max.) after 48 h at 80 °C under 20 kPa load	%	—	—	5	5	—	ISO 7616 or ISO 7850 as modified in 8.5.2
Compressive creep (max.) after 7 days at 70 °C under 40 kPa load	%	—	—	—	—	5	ISO 7616 or ISO 7850 as modified in 8.5.3
Water vapour permeability[b]							
23 °C/0 % to 50 % RH	ng/(Pa·s·m)	12 to 1,5		6,5 to 0,5		6,5 to 0,5	ISO 1663
Water absorption (max.)	% by volume	4		4		4	ISO 2896
Bending load at break (min.)	N	15	15	25	25	35	ISO 1209-1 as modified in 8.8

[a] Density is optional in a country that has established a system of class identification.

[b] A specific limiting value (maximum or minimum, depending on the application) may be selected by agreement between purchaser and supplier.

Annex A
(normative)

Amendments to ISO 12576-1

A.1 General

For the purposes of this International Standard, the requirements of ISO 12576-1 shall be followed except as listed below.

A.2 Amendments to ISO 12576-1:2001, Table 2 — Control of test equipment

The thermal-resistance and thermal-conductivity apparatus shall be calibrated or checked using an internal reference sample once per month.

A.3 Amendments and additions to ISO 12576-1:2001, Table 3 — Control of finished product for each production line

A.3.1 For EPS:

Density shall be determined in the dry state.

Compressive strength shall be checked once per week and at every change of product.

Compressive creep at 70 °C or 80 °C shall be checked once per week and at every change of product.

Bending load at break (fusion quality) shall be checked once per day and at every change of product.

A.3.2 For XPS:

Compressive strength shall be checked once every 2 h and at every change of product.

Compressive creep at 70 °C or 80 °C shall be checked once per week and at every change of product.

A.3.3 For PF:

Compressive creep at 70 °C or 80 °C shall be checked once per week and at every change of product.

Bending load at break shall be checked at every change of process unless it is covered by other properties checked with which a correlation has been established (indirect testing).

A.3.4 For PUR:

Compressive creep at 70 °C or 80 °C shall be checked once per week and at every change of product.