
**Thermal insulation for building
equipment and industrial
installations — Cellular glass products
— Specification**

*Isolation thermique pour les équipements de bâtiments et les
installations industrielles — Produits en verre cellulaire —
Spécifications*

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Contents

	Page
Foreword.....	iv
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	2
4 Symbols and abbreviated terms.....	2
5 Characteristics.....	3
5.1 General.....	3
5.2 Thermal conductivity.....	3
5.3 Compression strength.....	4
5.4 Dimensions.....	5
5.5 Bending strength.....	6
5.6 Point load.....	6
5.7 Compressive creep.....	7
5.8 Long-term water absorption.....	7
5.9 Water vapour diffusion resistance.....	7
5.10 Fire behaviour.....	7
5.11 Maximum service temperature.....	7
5.12 Minimum service temperature.....	7
5.13 Trace quantities of water-soluble ions and the pH-value.....	7
6 Test methods.....	8
6.1 Sampling.....	8
6.2 Conditioning.....	8
6.3 Testing.....	8
6.3.1 Test methods and specimen requirements.....	8
6.3.2 Thermal conductivity.....	9
7 Designation code.....	9
8 Marking and labelling.....	10
Annex A (normative) Factory production control (FPC).....	11
Annex B (informative) Product classification for flat products in respect of compressive strength and thermal conductivity.....	12
Bibliography.....	13

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 3, *Thermal insulation products, components and systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Thermal insulation for building equipment and industrial installations — Cellular glass products — Specification

1 Scope

This document specifies the requirements and test methods for factory-made cellular glass products, which are used for thermal insulation of building equipment and industrial installations, with an operating temperature range of approximately -265 °C to $+430\text{ °C}$. The products are manufactured in the form of slabs, faced or unfaced boards, pipe sections, segments and prefabricated ware.

This document describes product characteristics and test methods, designation code, marking and labelling.

This document does not apply to:

- products with a declared thermal conductivity greater than $0,065\text{ W/(m}\cdot\text{K)}$ at 10 °C ;
- products for the insulation of the building structure.

This document does not specify the required level of a given property to be achieved by a product to demonstrate fitness for purpose in a particular application. Specific requirements agreed between the purchaser and the supplier (e.g. type, dimensions and forms, regulatory compliance and inspection requirements or certification requirements), are outside the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1182, *Reaction to fire tests for products — Non-combustibility test*

ISO 1716, *Reaction to fire tests for products — Determination of the gross heat of combustion (calorific value)*

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 8497, *Thermal insulation — Determination of steady-state thermal transmission properties of thermal insulation for circular pipes*

ISO 9229, *Thermal insulation — Vocabulary*

ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test*

ISO 12570, *Hygrothermal performance of building materials and products — Determination of moisture content by drying at elevated temperature*

ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties — Cup method*

ISO 12624, *Thermal insulating products for building equipment and industrial installations — Determination of trace quantities of water-soluble chloride, fluoride, silicate, sodium ions and pH*

ISO 12628, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*

ISO 13787, *Thermal insulation products for building equipment and industrial installations — Determination of declared thermal conductivity*

ISO 16535, *Thermal insulating products for building applications — Determination of long-term water absorption by immersion*

ISO 18096, *Thermal insulating products for building equipment and industrial installations — Determination of maximum service temperature for preformed pipe insulation*

ISO 18097, *Thermal insulating products for building equipment and industrial installations — Determination of maximum service temperature*

ISO 29465, *Thermal insulating products for building applications — Determination of length and width*

ISO 29466, *Thermal insulating products for building applications — Determination of thickness*

ISO 29467, *Thermal insulating products for building applications — Determination of squareness*

ISO 29468, *Thermal insulating products for building applications — Determination of flatness*

ISO 29469, *Thermal insulating products for building applications — Determination of compression behaviour*

ISO 29472, *Thermal insulating products for building applications — Determination of dimensional stability under specified temperature and humidity conditions*

ISO 29771, *Thermal insulating materials for building applications — Determination of organic content*

EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9229 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

4 Symbols and abbreviated terms

b	width	mm
d	thickness	mm
l	length	mm
d_N	nominal thickness of the product	mm
D	pipe diameter	mm
λ	thermal conductivity	W/(m · K)

λ_D	declared thermal conductivity	W/(m · K)
μ	water vapour diffusion resistance factor	—
CG	cellular glass	—
CS	compression strength	kPa
PL(P)	pointload	mm
FPC	factory production control	—

5 Characteristics

5.1 General

Product properties shall be tested in accordance with [Clause 6](#). To be in conformity with this document, products shall meet the requirements of [5.2](#) to [5.13](#), where applicable.

A level is defined for a given value which is the upper or lower limit of a requirement. The level is given by the declared value of the characteristics concerned.

Slabs, boards, tapered or flat, fabricated ware and special shapes and pipe shells, pipe segments, sections and other special shapes are prefabricated from blocks by sawing, cutting, abrading, grinding, gluing or other methods of trimming.

The test methods that shall be used for determination of each property are given in [Table 7](#), which also shows the required test specimen dimensions and the minimum number of test specimens required to give one test result.

The test methods in ISO 8301, ISO 8302, ISO 18097, ISO 29465 or ISO 29466 for flat products apply to unfaced cellular glass boards. They also apply to core material used to produce faced cellular glass boards or to cut or abrade pipe insulation or prefabricated ware.

The test may be performed on the unfaced/uncoated product, if the facing/coating is known to have no influence on the property.

Since cellular glass pipe sections and prefabricated ware are sawed or abraded from flat products, only dimensions, squareness, pipe linearity, thermal conductivity and trace quantities of water-soluble chlorides and the pH-value shall be tested on preformed pipe sections, when relevant. This does not concern the factory production control, except for dimensions (see [Annex A](#)). As such, the mechanical characteristics of pipe sections and prefabricated ware are derived from the mechanical performances of the flat material from which the pipe sections or prefabricated ware are made.

One test result for a product property is the average of the measured values on the number of test specimens given in [Table 7](#).

For factory production control (FPC), see [Annex A](#).

5.2 Thermal conductivity

The manufacturer shall make a declaration for the thermal conductivity λ_D . The table or curve of conductivity versus temperature (from -170 °C to 350 °C, where applicable) shall be given according to ISO 13787. For factory production control, see [Annex A](#).

For flat specimens, thermal conductivity shall be based upon measurements carried out in accordance with ISO 8301 or ISO 8302. For cylindrical specimens, ISO 8497 shall be used.

In both cases, the thermal conductivity values shall be determined by the manufacturer and verified in accordance with ISO 13787. They shall be declared by the manufacturer according to the measurement

standards in ISO 8301, ISO 8302 or ISO 8497, covering the product service temperature range. The following conditions apply:

- the measured values shall be expressed with three significant figures;
- the declared thermal conductivity curve shall be given as a limit curve, defined in ISO 13787, where at least the λ_D (10 °C) shall be given;
- the values of the declared thermal conductivity, λ_D , shall be rounded upwards to the nearest 0,001 W/(m·K);
- the lowest reference mean test temperature required is – 170 °C;
- the λ_D (10 °C) shall not be greater than the value given in [Table 1](#), for the declared level.

The declared equation/limit curve is the ‘declared reference’ with three significant figures, i.e. to 0,000 1 W/(m·K) for values below 0,1 W/(m·K) and in 0,001 W/(m·K) for values above 0,1 W/(m·K). This shall be used as a reference for the verification of the declaration.

When thermal conductivity is declared as a table derived from the equation, the rounding upwards to the next 0,001 W/(m·K) shall be done for the full range of the thermal conductivity.

NOTE 1 Determinations of the declared thermal conductivity of pipe sections, following ISO 8497, having joints in the metering area, include the effects of these joints as defined in ISO 23993.

NOTE 2 The thermal conductivity for prefabricated ware in general can be up to 5 % higher, at ambient temperature, than when it is tested on its initial flat block out of which it is made.

NOTE 3 [Annex B](#) gives a possible product classification for flat products in respect to thermal conductivity and compressive strength.

Table 1 — Levels for thermal conductivity for flat products

Level ^a	Requirement of λ_D (10 °C) W/(m·K)
λ_{040}	≤0,040
λ_{041}	≤0,041
λ_{042}	≤0,042
λ_{043}	≤0,043
λ_{044}	≤0,044
λ_{045}	≤0,045
λ_{048}	≤0,048
λ_{050}	≤0,050
λ_{052}	≤0,052
λ_{054}	≤0,054
λ_{056}	≤0,056
λ_{058}	≤0,058
λ_{060}	≤0,060
λ_{065}	≤0,065

^a Levels below λ_{040} or in steps in between may also be considered.

5.3 Compression strength

The compression strength shall be determined in accordance with ISO 29469. No test result for the compressive stress strength shall be less than the value given in [Table 2](#) for the declared level.

Table 2 — Levels for compressive strength

Level	Requirement kPa
CS400	≥400
CS500	≥500
CS600	≥600
CS700	≥700
CS800	≥800
CS900	≥900
CS1000	≥1 000
CS1200	≥1 200
CS1400	≥1 400
CS1600	≥1 600
CS1800	≥1 800
CS2000	≥2 000
CS2200	≥2 200
CS2400	≥2 400
CS2800	≥2 800
CS3000	≥3 000

NOTE It is generally known that the mechanical and the thermal performances are inversely related. [Annex B](#) gives a possible product classification for flat products in respect to compressive strength and thermal conductivity.

5.4 Dimensions

The length, l , width, b and thickness d , of the board, shall be determined in accordance with ISO 29465 and ISO 29466. No test result shall deviate from the nominal values by more than the tolerances given in [Table 3](#). The dimension of the pipe shall be determined in accordance with ISO 12628. No test result shall deviate from the nominal values by more than the tolerances given in [Table 4](#).

Table 3 — Board dimension tolerances

Item	Tolerance
l	±2 mm
b	±2 mm
d	±2 mm
Flatness	±2 mm
Squareness	Length and width ±5 mm/m
	Thickness ±2 mm

Table 4 — Pipe dimension tolerances

Item	Tolerance
<i>l</i>	±2 mm
<i>d</i>	±2 mm
<i>D</i>	-0 to +4 mm
Pipe section linearity	±2 mm

5.5 Bending strength

The bending strength shall be determined in accordance with EN 12089. The test result shall meet the requirements given in [Table 5](#) for the declared level.

Table 5 — Bending strength

Level	Requirement kPa
BS200	≥200
BS250	≥250
BS300	≥300
BS350	≥350
BS400	≥400
BS450	≥450
BS500	≥500
BS600	≥600
BS700	≥700
BS800	≥800
BS900	≥900
BS1000	≥1 000
BS1100	≥1 100
BS1200	≥1 200
BS1300	≥1 300
BS1400	≥1 400

5.6 Point load

Deformation under a point load of 1 000 N, of boards and slabs, shall be determined in accordance with ISO 29769. No test result shall exceed the value given in [Table 6](#) for the declared level.

Table 6 — Point load

Level	Requirement mm
PL(P)2	≤2,0
PL(P)1,5	≤1,5
PL(P)1	≤1,0
PL(P)0,5	≤0,5

5.7 Compressive creep

The compressive creep shall be determined in accordance with ISO 16534. The test result shall meet the declared level.

5.8 Long-term water absorption

The long-term water absorption by partial immersion shall be determined in accordance with ISO 16535. The test result shall not be greater than 0,5 kg/m².

5.9 Water vapour diffusion resistance

The water vapour diffusion resistance factor, μ , shall be determined in accordance with ISO 12572. The test result shall not be less than 40 000.

5.10 Fire behaviour

The reaction of fire characteristics of the product as placed on the market shall be determined in accordance with ISO 1182, ISO 1716, ISO 11925-2 or ISO 29771. The test result shall meet the declared level.

5.11 Maximum service temperature

The maximum service temperature for flat products shall be determined in accordance with ISO 18097.

At the maximum service temperature, no test result shall have a variation of dimensions exceeding 2 mm.

Cellular glass pipe sections and prefabricated wares are sawed, cut, glued, abraded or ground from flat boards or billets. Consequently, the maximum service temperature, ST(+), shall be determined only on flat boards, in accordance with ISO 18097. In case of need, direct determination of maximum service temperature for pipe sections shall be carried out in accordance with ISO 18096, choosing a temperature gradient of 50 °C/h.

5.12 Minimum service temperature

The minimum service temperature shall be determined in accordance with ISO 29472 at the declared minimum service temperature without a specified relative humidity.

At the minimum service temperature, no test result shall have a variation of dimensions exceeding 0,5 % for length and width and 1,0 % for thickness.

Below an operating temperature of -50 °C, special tests regarding the suitability of the product in the intended application are recommended (e.g. liquefaction of oxygen). Manufacturer's advice should be used in all cases.

5.13 Trace quantities of water-soluble ions and the pH-value

Trace quantities of water-soluble chloride, fluoride, silicate and sodium ions and the pH-value shall be determined in accordance with ISO 12624. The manufacturer shall declare one or more as appropriate as levels in mg per kg of product and the pH-value as levels in steps of 0,5. For chloride and fluoride, no test result shall exceed the declared value. For silicate and sodium, no test result shall be below the declared value. For the pH-value, no test result shall deviate from the declared value by more than 1,0.

6 Test methods

6.1 Sampling

Test specimens shall be taken from the same sample, with a total area not less than 5 m², and shall be sufficient to cover the tests needed. The shorter side of the sample shall not be less than 300 mm or the full size of the product, whichever is the smaller.

Pipe section specimens shall be taken from a sample consisting of at least three full size sections.

6.2 Conditioning

The test specimens shall be conditioned according to ISO 12570 at (23 °C ± 5 °C) until constant mass is reached.

The constant mass is reached when the change of mass between three consecutive weighings made 24 h apart is less than 0,1 % of the total mass. The conditioning shall be noted on the test report.

6.3 Testing

6.3.1 Test methods and specimen requirements

[Table 7](#) provides the dimensions of the test specimens and the minimum number of measurements required to obtain one test result.

Testing may be performed on unfaced/uncoated product if the facing/coating is shown to have no relevance to the test result.

Since cellular glass pipe sections and prefabricated ware are sawed or abraded from flat products, only dimensions, squareness, inside diameter, pipe linearity and long-term water absorption shall be tested on preformed pipe sections, when relevant. This does not concern the FPC, except for dimensions.

Table 7 — Test methods, test specimens and specific conditions

Subclause in this document		Test method	Test specimen length, width and thickness	Minimum number of measurements to get one test result
No.	Title			
5.2	Thermal conductivity	ISO 8301	ISO 8301	1
		ISO 8302	ISO 8302	
		ISO 8497	ISO 8497	
5.3	Compression strength	ISO 29469	200 mm × 200 mm	5
5.4	Length and width	ISO 12628	Full-size	3
	Thickness	ISO 29465		
	Squareness	ISO 29466		
	Flatness	ISO 29467		
	Inside diameter	ISO 29468		
	Pipe section linearity			
5.5	Bending strength	EN 12089	EN 12089	5
5.6	Point load	ISO 29769	Full-size	1
5.7	Compressive creep	ISO 16534	200 mm × 200 mm	3
5.8	Long-term water absorption by partial immersion	ISO 16535 Method 1B	200 mm × 200 mm	4

Table 7 (continued)

Subclause in this document		Test method	Test specimen length, width and thickness	Minimum number of measurements to get one test result
No.	Title			
5.9	Water vapour diffusion resistance	ISO 12572 Set A of test conditions shall be chosen unless the application imposes set B or C	ISO 12572	5
5.10	Fire behaviour	ISO 1182 ISO 1716 ISO 11925-2 ISO 29771	ISO 1182 ISO 1716 ISO 11925-2 ISO 29771	5
5.11	Maximum service temperature	ISO 18097	ISO 18097	1
5.12	Minimum service temperature	ISO 29472	ISO 29472	3
5.13	Trace quantities of water-soluble ions and the pH-value	ISO 12624	ISO 12624	1

6.3.2 Thermal conductivity

Thermal conductivity for flat products shall be determined in accordance with ISO 8301 or ISO 8302. For cylindrical specimens ISO 8497 shall be applied.

The thermal conductivity shall be determined for the full temperature range of the product. The lowest reference mean test temperature required is -170 °C. For FPC, see [Annex A](#).

Thermal conductivity shall be determined directly at measured thickness. In the event that this is not possible, it shall be determined by measurements on other thicknesses of the product, provided that the product is of similar chemical and physical characteristics and is produced on the same production unit.

When measured thickness is used for testing of thermal resistance and thermal conductivity, the test thickness shall be the smallest of the measured values on the test specimens (not the mean value), as far as possible to avoid any air gaps during testing.

7 Designation code

A designation code for the product shall be given by the manufacturer. The following shall be included except when there is no requirement for a property described in [6.3](#):

- the cellular glass abbreviated term, CG;
- the product type, board or pipe;
- relevant levels for the given characteristic;
- a table or formula of thermal conductivity for the full temperature range (see [6.3.2](#));
- the nominal thickness, d_N , in mm;
- a reference to this document, i.e. ISO 24285:2022

The designation code for a CG product is illustrated by the following example:

CG Board ISO 24285:2022-CS400- λ 043-*l* 600-*b*300-*d* 50-BS200-PL(P)0.5-ST(+)*300*

8 Marking and labelling

Products that make reference to the provisions of this document shall be marked clearly, on the product, label or packaging, with the following information:

- the product name or other identifying characteristic;
- the name or identifying mark and address of the manufacturer;
- the shift, time of production or traceability code;
- the designation code, as given in [Clause 7](#);
- the type of facing, if any;
- the number of pieces or area in the package, as appropriate.

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