
**Thermal insulation products —
Aerogel blanket for buildings —
Specification**

*Produits isolants thermiques — Aérogels en matelas pour les
bâtiments — Spécifications*

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions, symbols and abbreviated terms	2
3.1 Terms and definitions	2
3.2 Symbols and units	2
3.3 Abbreviated terms	2
3.3.1 Abbreviated terms	2
3.3.2 Abbreviated terms for declared properties	3
4 Requirements	3
4.1 General	3
4.2 For all applications	3
4.2.1 Linear dimensions	3
4.2.2 Density	4
4.2.3 Thermal conductivity	4
4.3 Specific applications	4
4.3.1 Reaction to fire	4
4.3.2 Water absorption	4
4.3.3 Compressive strength	4
4.3.4 Corrosiveness to steel	5
4.3.5 Resistance to fungi	5
4.3.6 Flexibility	5
5 Test methods	5
5.1 Sampling	5
5.2 Conditioning	6
5.3 Testing	6
5.3.1 General	6
5.3.2 Thermal conductivity	6
6 Designation code	7
7 Evaluation of conformity	7
8 Marking and labelling	7
Annex A (normative) Factory production control	9
Annex B (normative) Determination of the aged values of thermal conductivity due to moisture	10
Annex C (normative) Determination of the thermal conductivity in relation to moisture content	12
Bibliography	14

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.

Introduction

Aerogel insulations are widely used globally because of their superior properties including ease of handling and effective insulating performance. Testing of aerogel insulation to meet sustainable construction needs provides users with a basis for choosing the insulation.

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Thermal insulation products — Aerogel blanket for buildings — Specification

1 Scope

This document specifies the requirements for factory-made aerogel blankets, which are used for the thermal insulation of building applications. This document specifies insulation that exhibits thermal insulating performance through high porosity and nano-sized pores by compounding aerogel with net-like fibrous material, e.g. polyester, glass fibre, ceramic fibre. The products are delivered as a blanket type.

This document describes product characteristics and includes procedures for testing, evaluation of conformity and marking and labelling.

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.

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 846:2019, *Plastics — Evaluation of the action of microorganisms*

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

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

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

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

ISO 29470, *Thermal insulating products for building applications — Determination of the apparent density*

ISO 29767, *Thermal insulating products for building applications — Determination of short-term water absorption by partial immersion*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the following terms and definitions 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/>

3.1 Terms and definitions

3.1.1

aerogel

insulating material that has high porosity derived from a nanoporous structure formed by replacement of the liquid component of a gel with air

3.1.2

aerogel blanket

aerogel insulation which has been made into a blanket by combining *aerogel* (3.1.1) with a flexible matrix material as carrier

3.2 Symbols and units

Symbol	Quantity	Unit
b	width	mm
L	length	mm
t	thickness	mm
λ	thermal conductivity	W/(m·K)
$\Delta\lambda_a$	ageing increment of thermal conductivity ($\lambda_a - \lambda_i$)	W/(m·K)
λ_D	declared thermal conductivity as determined by ISO 10456, and expressed with two significant digits	W/(m·K)
λ_a	time averaged value of thermal conductivity over 25 years	W/(m·K)
λ_{mean}	mean thermal conductivity	W/(m·K)
$\lambda_{\text{mean},a}$	mean of the aged values of thermal conductivity	W/(m·K)
$\lambda_{\text{mean},i}$	mean of the initial values of thermal conductivity	W/(m·K)
$\lambda_{90/90}$	90 % fractile with a confidence level of 90 % for the thermal conductivity	W/(m·K)
k_a	factor related to the number of test results of aged thermal conductivity	-
k_i	factor related to the number of test results of initial thermal conductivity	-
s_λ	estimate of the standard deviation of the thermal conductivity	W/(m·K)
$s_{\lambda,a}$	estimate of the standard deviation of the aged values of thermal conductivity	W/(m·K)
$s_{\lambda,i}$	estimate of the standard deviation of the initial values of thermal conductivity	W/(m·K)

3.3 Abbreviated terms

3.3.1 Abbreviated terms

Abbreviated term	Meaning
ABI	Aerogel blanket insulation

Abbreviated term	Meaning
ITT	Initial type test
FPC	Factory production control

3.3.2 Abbreviated terms for declared properties

Abbreviated term	Declared property
CS(Y)	Declared level for compressive strength
CS(10)	Declared level for compressive strength at 10 % deformation
Cl	Declared level for chloride content
T	Declared level for thickness

4 Requirements

4.1 General

Product properties shall be assessed in accordance with [Clause 5](#). To be in conformance with this document, products shall meet the requirements of [4.2](#) and [4.3](#), as appropriate.

The test methods for determination of each property are given in [Table 5](#), which also shows the required test specimen dimensions and the minimum number of test specimens required to give one test result.

One test result for a product property is the average of the measured values on the number of test specimens given in [Table 5](#).

4.2 For all applications

4.2.1 Linear dimensions

Length and width shall be measured in accordance with ISO 29465 for each of the four specimens.

A minimum of four measurements shall be made for each dimension. Each value shall be within the tolerances specified in [Table 1](#).

The thickness of aerogel insulation shall be measured in accordance with ISO 29466 by using a square plate under pressure of not less than 250 Pa and shall be subject to the tolerances detailed in [Table 1](#). The pressure employed during measurement shall be disclosed.

Tighter tolerances can be necessary for certain applications; this shall be agreed to by the supplier and purchaser.

Table 1 — Dimensional tolerances

Length (%)	Width (%)	Thickness (%)	
±5	±5	T1	−0 / +3
		T2	−0 / +5
		T3	−0 / +10
		T4	−0 / +15
		T5	−0 / +20
If more restrictive tolerances are required, these shall be agreed between purchaser and supplier.			

4.2.2 Density

Density shall be determined in accordance with ISO 29470 in each of the four specimens and reported as the average of the four specimens.

4.2.3 Thermal conductivity

For thermal conductivity testing, the specimen shall be conditioned according to 5.2.

Thermal conductivity shall be based upon measurements carried out in accordance with ISO 8301 or ISO 8302.

The measured values shall be expressed with three significant figures and the test mean temperatures shall be according to Table 2 (10 °C or 23 °C) depending on the usage environment and requirement.

The declared thermal conductivity shall be determined in accordance with ISO 10456.

The test method for aged value of thermal conductivity due to moisture and the test method for thermal conductivity relation to moisture content shall be carried out as specified in Annex B and Annex C.

Table 2 — Thermal conductivity category

Thermal conductivity (λ)	Test mean temperature
	10 °C
	23 °C

4.3 Specific applications

4.3.1 Reaction to fire

Application of these tests presupposes awareness of possible legislation regarding reaction to fire in the individual territories where the product is to be used. The fire properties with respect to reaction to fire should be assessed.

4.3.2 Water absorption

The test shall be conducted in accordance with the test method in ISO 29767 or in ISO 16535.

ISO 29767 specifies the equipment and procedures for determining the short-term water absorption of specimens by partial immersion.

ISO 16535 specifies the equipment and procedures for determining the long-term water absorption of test specimens.

4.3.3 Compressive strength

Compressive strength at 10 % deformation shall be determined in accordance with ISO 29469. The test result shall not be less than the declared level, CS(10\Y), given in Table 3.

One test result for a product is the average of the measured values on the number of four specimens.

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

Table 3 — Levels for compressive strength at 10 % deformation

Level	Requirement kPa
CS(10\Y)1	≥ 1

Table 3 (continued)

Level	Requirement kPa
CS(10\Y)5	≥5
CS(10\Y)25	≥25
CS(10\Y)50	≥50
CS(10\Y)75	≥75
CS(10\Y)100	≥100

4.3.4 Corrosiveness to steel

This test is for determining trace quantities of the water-soluble chloride ions in an aqueous extract of the product which shall be carried out in accordance with ISO 12624. Trace quantities of water-soluble chloride ions shall be declared as levels in milligrams per kilogram of product and no test result shall exceed the declared value.

NOTE The determination of this parameter can be relevant for thermal insulating products intended for applications to austenitic stainless-steel surfaces. The presence of chloride ions under certain conditions can influence the risk of stress corrosion cracking.

4.3.5 Resistance to fungi

When tested according to ISO 846, which provides a test method for fungi resistance, test strains listed in Table 4 shall be used. Test specimens that have growth greater than that on the comparative item shall be considered to have failed. Test specimens on which the growth is not greater than that on the comparative item shall be considered to have passed.

Table 4 — Types of fungi to be tested

Name	Strain
Aspergillus niger van Tieghem	ATCC 6275
Penicillium funiculosum Thom	CMI 114933
Paecilomyces variotii Bainier	ATCC 18502
Gliocladium virens Miller et al.	ATCC 9645
Chaetomium globosum Kunze: Fries	ATCC 6205

4.3.6 Flexibility

Flexibility test methods and procedures are as follows.

The test specimen size is (300 x 300) mm. Place the insulation on the ½ NPS (21,3 mm outer diameter), gently bend the specimen at a 90° angle and observe if the outer surface shows rupture. If none, then the 'flexible' classification is given. There shall be no visible ruptures on the four specimens tested

5 Test methods

5.1 Sampling

Sufficient test specimens shall be taken in accordance with the following test methods.

5.2 Conditioning

Prior to dimensional measurements and physical-property testing, unless otherwise specified in the test method, the test specimens shall be conditioned, with all surfaces exposed, for a minimum of 24 h at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity (RH).

When measuring the dimensions of an aerogel blanket with full size width or length $>1,5$ m, the conditioning step set above is not required, and may be eliminated at the manufacturer's discretion.

5.3 Testing

5.3.1 General

Table 5 gives the dimensions of the test specimens. It provides the minimum number of measurements required to get one test result and any specific conditions which are necessary.

Table 5 — Test methods, test specimens and conditions

Clause		Test method	Test specimens		Specific conditions
No.	Title		Dimensions (mm)	Minimum number to get one test result	
4.2.1	Linear dimensions	ISO 29465 ISO 29466	Full-size	4	—
4.2.2	Density	ISO 29470	Full-size	4	—
4.2.3	Thermal conductivity	ISO 8301 or ISO 8302	$\geq 200 \times 200 \times t$	1	—
4.3.1	Reaction to fire	—	—	—	—
4.3.2	Water absorption	ISO 29767 or ISO 16535	$200 \times 200 \times t$ $200 \times 200 \times t$	4 4	—
4.3.3	Compressive strength	ISO 29469	See ISO 29469:2008, 6.1	4	—
4.3.4	Corrosiveness to steel	ISO 12624	—	3	7,5 g
4.3.5	Resistance to fungi	ISO 846	See ISO 846:2019, 6.1	3	—
4.3.6	Flexibility	—	$300 \times 300 \times t$	4	—

5.3.2 Thermal conductivity

The thermal conductivity shall be determined in accordance with ISO 8301 or ISO 8302 and under the following conditions:

- at a mean temperature of $(10 \pm 0,3) ^\circ\text{C}$ or at a mean temperature of $(23 \pm 0,3) ^\circ\text{C}$;
- after conditioning in accordance with [5.2](#);
- if thermal conductivity of the conditioned specimen differs by more than 5 % from dry condition, then redeclare;
- the thermal conductivity shall be determined directly at the measured thickness.

When measured thickness is used for testing of thermal conductivity, the test thickness shall be the smallest of the measured points on the test specimen (and not the mean) as far as possible to avoid any air gaps during testing. The measurements of thickness shall be determined directly on the aerogel insulation according to ISO 29466.

6 Designation code

A designation code for the products shall be given by the manufacturer. The following shall be included except when there is no requirement for a property described in [4.3](#).

The aerogel blanket insulation abbreviated term	ABI
This document number	ISO 22482
Width and length	<i>b</i> and <i>l</i>
Thickness	<i>t</i>
Thermal conductivity	λ_D
Compressive strength	CS(10/Y)

The designation code for an aerogel blanket insulation product is illustrated by the following example:

EXAMPLE **ABI — ISO XXXX — *b*300 — *l*300 — *t*10 — λ_D 0,015W/(m·K) — CS(10/Y)100**

7 Evaluation of conformity

The evaluation of conformity shall be carried out in accordance with ISO 12576-1 and shall be based in initial type testing (ITT) and factory production control (FPC) by the manufacturer, including product assessment and tests on samples taken at the factory.

ITT shall be carried out in accordance with ISO 12576-1 for all characteristics declared.

The declared thermal conductivity, λ_D , shall be determined according to the requirements of ISO 10456, and declared to two significant digits. FPC testing shall be made for the characteristics listed in [Annex A](#), with no additional testing where the frequency is noted as ITT.

If a manufacturer decides to group its products, it shall be done in accordance with ISO 12576-1.

The minimum frequencies of tests in the factory production control shall be in accordance with [Annex A](#). When indirect testing is used, the correlation to direct testing shall be established in accordance with ISO 12576-1.

The manufacturer or its authorized representative shall make available, in response to a request, a certificate or declaration of conformity as appropriate.

8 Marking and labelling

Products conforming to this document shall be clearly marked, either on the label or on the packaging, with the following information:

- product name or other identifying characteristic;
- name or identifying mark and address of the manufacturer or its authorised representative;
- year of manufacture (the last two digits);
- shift or time of production and manufacturing plant or traceability code;
- reaction to fire safety of the product as placed on the market in accordance with the test methods specified in [4.3.1](#);
- declared thickness;
- designation code as given in [Clause 6](#);

- number of pieces and area in the package, as appropriate.

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Annex A (normative)

Factory production control

Table A.1 — Minimum product testing frequencies

Subclause		Minimum testing frequency ^a
No.	Title	
4.2.1	Linear dimensions	once per production batch ^c
4.2.2	Density	once per production batch ^c
4.2.3	Thermal conductivity	ITT ^b and once every six months ^d
4.3.1	Reaction to fire	See 4.3.1
4.3.2	Water absorption	ITT ^b and once every six months ^d
4.3.3	Compressive strength	once per production batch ^c
4.3.4	Corrosiveness to steel	ITT ^b and once every six months ^d
4.3.5	Resistance to fungi	ITT ^b and once every six months ^d
4.3.6	Flexibility	once per production batch ^c

^a The minimum testing frequencies, expressed in test results, shall be understood as the minimum for continuous production for each production unit/line under stable conditions. In addition to the testing frequencies given above, testing of relevant properties of the product shall be repeated when changes or modifications are made which are likely to affect the conformity of the product. For ITT and FPC, units using the same process in one factory are considered together (as one production line).

For mechanical properties, the testing frequencies given are independent of the change of product. In addition, the manufacturer shall establish internal rules for process adjustments related to these properties when changing the product.

^b ITT, see ISO 12576-1.

^c The manufacturer may declare the size of production batch for the purposes of FPC testing in the FPC document. The maximum size of a production batch for FPC testing purposes shall be no larger than a single production campaign representing 7 days continuous production.

^d Testing shall not be required if production of the subject aerogel blanket insulation has not been performed during the six month period.

Annex B **(normative)**

Determination of the aged values of thermal conductivity due to moisture

B.1 General

This annex covers products of aerogel insulation. It provides one method for the determination of the aged values of thermal conductivity due to moisture.

B.2 Preparation of test sample

B.2.1 Sampling

The test sample shall be taken from the full-size product.

B.2.2 Dimensions

The dimension of insulation products should be in accordance with the dimension of the guarded hot plate or the heat flow meter.

B.2.3 Conditioning

The test samples shall be conditioned at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \% \text{ RH}$ to constant weight.

B.3 Determination of the initial value of thermal conductivity

- Prepare the test sample for thermal conductivity measurement in accordance with [B.2](#).
- Measure the thermal conductivity of the test sample in accordance with [5.3.2](#).
- Report the initial value of thermal conductivity to the nearest 0,000 1 W/(m·K).

B.4 Determination of aged value of thermal conductivity

B.4.1 Test sample

The test sample shall exclude any facing, skins, etc. and shall be tested at product thickness after preparation in accordance with [B.2](#).

B.4.2 Ageing conditions

Age the product at $(60 \pm 2) ^\circ\text{C}$ and $(80 \pm 5) \% \text{ RH}$ for a period of six months.

B.4.3 Determination of the aged value of thermal conductivity

- Measure the thermal conductivity of the aged test sample in accordance with [5.3.2](#).
- Report the aged value of thermal conductivity to the nearest 0,000 1 W/(m·K).

B.5 Declaration of thermal conductivity

B.5.1 General

Both the initial or the aged value of thermal conductivity shall be based on the statistical calculations. The initial values shall be determined in accordance with [B.3](#) and the aged values in accordance with [B.4.3](#).

B.5.2 Initial values of thermal conductivity used to calculate the $\lambda_{90/90}$ values

$$\lambda_{90/90} = \lambda_{\text{mean},i} + k_i \times s_{\lambda i} + \Delta\lambda_a$$

B.5.3 Aged values of thermal conductivity used to calculate the $\lambda_{90/90}$ values

$$\lambda_{90/90} = \lambda_{\text{mean},a} + k_a \times s_{\lambda a}$$