
**Thermal insulation products for
building equipment and industrial
installations — Expanded perlite
products — Specification**

*Isolation thermique pour les équipements de bâtiments et les
installations industrielles — Produits de perlite expansée —
Spécifications*

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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.

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 document 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).

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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 products for building equipment and industrial installations — Expanded perlite products — Specification

1 Scope

This document specifies the requirements for factory-made expanded perlite products which are used for thermal insulation of industrial installations and building equipment with an operating temperature from 23 °C to ~ 1 000 °C.

The products are manufactured in the form of boards, pipe sections, segments, prefabricated ware and special ware.

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

Products covered by this document are also used in prefabricated thermal insulation systems and composite panels; the structural performance of systems incorporating these products is not covered.

This document does not specify the required level or class of a given property required to be achieved by a product in order to demonstrate fitness for purpose in a particular application. The levels required for a given application can be found in regulations and invitations to tender.

This document is not applicable to:

- a) products with a declared thermal conductivity greater than 0 072 W/(m·K) at 70 °C;
- b) products intended to be used for the insulation of the building structure;
- c) the acoustical aspects
 - 1) direct airborne sound insulation, and
 - 2) impact noise transmission index.

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 heat of combustion (calorific value)*

ISO 2477, *Shaped insulating refractory products — Determination of permanent change in dimensions on heating*

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 8894-1, *Refractory materials — Determination of thermal conductivity — Part 1: Hot-wire methods (cross-array and resistance thermometer)*

ISO 6334:2023(E)

ISO 9053, *Acoustics — Determination of airflow resistance*

ISO 9229, *Thermal insulation — Vocabulary*

ISO 11654, *Acoustics — Sound absorbers for use in buildings — Rating of sound absorption*

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

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

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

ISO 21129, *Hygrothermal performance of building materials and products — Determination of water-vapour transmission properties — Box method*

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 29469:2022, *Thermal insulating products for building applications — Determination of compression behaviour*

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

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

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

ISO 5017, *Dense shaped refractory products — Determination of bulk density, apparent porosity and true porosity*

ISO 8841, *Dense, shaped refractory products — Determination of permeability to gases*

ISO 20392, *Thermal-insulating materials — Determination of compressive creep*

ISO 16537, *Thermal insulating products for building applications — Determination of shear behaviour*

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

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 12629, *Thermal insulating products for building equipment and industrial installations — Determination of water vapour transmission properties of preformed pipe insulation*

ISO 18099, *Thermal insulating products for building equipment and industrial installations — Determination of the coefficient of thermal expansion*

ISO 12623, *Thermal insulating products for building equipment and industrial installations — Determination of short-term water absorption by partial immersion of preformed pipe insulation*

3 Terms, definitions, symbols, units and abbreviated terms

3.1 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 9229 and the following 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/>

3.1.1

production line

equipment that produces products in a continuous process

Note 1 to entry: For initial type test (ITT) and factory production control (FPC), each line is considered separately.

3.1.2

production unit

equipment that produces products in a discontinuous process

Note 1 to entry: For initial type test (ITT) and factory production control (FPC), units using the same process in one factory are considered together (as one production line).

3.2 Symbols, units and abbreviated terms

3.2.1 Symbols and units

Symbol	Quantity	Unit
d	inside diameter of pipe section	mm
b	width	mm
t	thickness	mm
t_D	declared thickness of the product	mm
S_{lin}	deviation from linearity	mm
l	length	mm
S_b	deviation from squareness of boards on length and width	mm/m
S_t	deviation from squareness of boards on thickness	mm
S_p	deviation from squareness for pipe insulation	mm
S_{max}	deviation from flatness	mm
$\Delta\varepsilon_l$	relative change in length	%
$\Delta\varepsilon_b$	relative change in width	%
$\Delta\varepsilon_t$	relative change in thickness	%
λ	thermal conductivity	W/(m·K)
λ_D	declared thermal conductivity	W/(m·K)
μ	water vapour diffusion resistance factor	—
σ_m	bending strength	kPa
ρ_a	apparent density	kg/m ³

3.2.2 Abbreviated terms for declared properties

Abbreviated term	Declared property
CS(5/Y)	declared level for compressive stress at 5 % deformation
Cl	declared level for chloride content
F	declared level for fluoride content
Na	declared level for sodium
K	declared level for potassium content
pH	declared level for pH
L	declared class for length tolerances
MU	declared value for water vapour diffusion resistance factor
P	declared value for flatness tolerances
S	declared class for squareness tolerances
ST	declared level for maximum service temperature
T	declared class for thickness tolerances
W	declared class for width tolerances

3.2.3 Abbreviated terms

Abbreviated term	Full term
EP	Expanded perlite
ITT	Initial type test
ML	Manufacturer's literature
FPC	Factory production control
ST	Service temperature

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 the requirements of [4.3](#), as appropriate.

The test methods to be used for determination of each property are given in [Table 4](#), 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 4](#).

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

4.2 For all applications

4.2.1 Thermal conductivity

The thermal conductivity values shall be declared by the manufacturer at reference mean temperatures covering the product ST range. The following conditions apply:

- the measured values shall be expressed with three significant figures;
- the declared conductivity curve shall be given as a limit curve, as defined in ISO 13787.

4.2.2 Dimensions and tolerances

4.2.2.1 Linear dimensions

The length, l , width, b , and thickness, t , of boards and the dimensions of pipe sections and prefabricated ware shall be declared. When determined, no test result shall deviate from the declared values by more than the tolerance given in [Table 1](#).

Table 1 — Dimensional tolerances

Form of delivery	Length	Width	Thickness	Inside diameter
Board	± 3 mm or $\pm 0,6$ % ^a	± 3 mm or $\pm 0,4$ % ^a	$\begin{matrix} +3 \\ -2 \end{matrix}$ mm	
Pipe section or segment	± 3 mm or $\pm 0,6$ % ^a		$\begin{matrix} +3 \\ -2 \end{matrix}$ mm	0 mm to ± 5 mm

^a Whichever gives the greatest numerical tolerance.

4.2.2.2 Squareness

The deviation from squareness of boards on length and width, S_b , shall not exceed 6 mm/m and the deviation from squareness of boards on thickness, S_v , shall not exceed 2 mm. For pipe sections and segments, the deviation from squareness, S_p , shall not exceed 3 mm.

4.2.2.3 Flatness

The deviation from flatness, S_{max} , shall not exceed 6 mm.

4.2.2.4 Pipe section linearity

The deviation from linearity, S_{lin} , shall not exceed 3 mm or 0,6 % on length, whichever gives the greatest numerical tolerance.

4.2.3 Dimensional stability

Standard atmospheres used for initial and final conditioning shall be chosen in accordance with [5.2](#).

The test shall be carried out after storage for 48 h at (23 ± 2) °C and (90 ± 5) % relative humidity. The relative changes in length, $\Delta\varepsilon_l$, width, $\Delta\varepsilon_b$, and thickness, $\Delta\varepsilon_v$, shall not exceed 1,0 %.

4.2.4 Fire properties

Fire properties with respect to reaction to fire should be assessed, taking into consideration the applicable legislation and building codes in the individual territories in which the product is to be used.

4.2.5 Durability characteristics

4.2.5.1 General

The appropriate durability characteristics have been considered and are covered in [4.2.5.2](#), [4.2.5.3](#) and [4.2.5.4](#).

4.2.5.2 Durability of fire properties against ageing/degradation and high temperature

The fire properties in respect to reaction to fire performance of EP products does not change with time or when subjected to high temperature.

4.2.5.3 Durability of thermal resistance against ageing/degradation

The thermal conductivity of EP products does not change with time.

4.2.5.4 Durability of thermal resistance against high temperature

The thermal conductivity of EP products does not change with time at a high temperature.

4.3 For specific applications

4.3.1 General

If there is no requirement for a property, described in 4.3 for a product in use, then that property need not be determined and declared by the manufacturer.

If a property described in 4.3 is declared, it shall be determined in accordance with the test method shown in Table 4.

NOTE For information on additional properties, see Annex B.

4.3.2 Maximum service temperature (ST)

The maximum ST for flat products shall be determined in accordance with ISO 2477.

At the maximum ST, the relative changes in length, $\Delta\epsilon_l$, and width, $\Delta\epsilon_b$, shall not exceed 2 %. The maximum ST, shall be declared in °C in levels with steps of 50 °C as given in the examples shown in Table 2. The test specimen shall not exhibit evidence of self-heating.

Table 2 — Levels for maximum service temperature (ST)

Level	Requirement °C
ST 650	≥650
ST 700	≥700
ST 750	≥750
ST 800	≥800
ST 850	≥850
ST 900	≥900
ST 950	≥950
ST 1 000	≥1 000

4.3.3 Compressive stress or strength

No test result shall be lower than the value, given in Table 3, for the declared level.

Table 3 — Levels for compressive stress at 5 % deformation or compressive strength

Level	Requirement kPa
CS (5/Y) 300	> 300
CS (5/Y) 350	> 350
CS (5/Y) 400	> 400
CS (5/Y) 450	> 450
CS (5/Y) 500	> 500
CS (5/Y) 550	> 550

NOTE ISO 29469 is not applicable to pipe sections.

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

Trace quantities of water-soluble ions and the pH-value shall be declared as levels in milligrams per kilogram 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 sodium and potassium, 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.

4.3.5 Water vapour diffusion resistance

Expanded perlite products are used for applications at high temperatures where high humidity and water adsorption are irrelevant. In exceptional cases, the water vapour diffusion resistance factor, μ , may be measured and declared.

4.3.6 Short-term water absorption by partial immersion

Expanded perlite products can absorb water under poor storage conditions. If necessary, the product may be tested for short-term water absorption by partial immersion.

5 Test methods

5.1 Sampling

Flat test specimens shall be taken from the same sample and be sufficient to cover the needed tests. Pipe section specimens shall be taken from a sample consisting of at least three full-sized sections.

If this is not possible, the properties of the product shall be measured on the boards from which the product is fabricated. In all cases, dimensions and, when relevant, squareness and flatness shall be measured on the finished product.

5.2 Conditioning

Test specimens shall be conditioned to constant mass as specified in ISO 12570. The surfaces of the test specimens shall be free of dust and water. Constant mass is reached when the change of mass between three consecutive weighing made 24 h apart is less than 0,1 % of the total mass

In cases of dispute or when obtaining comparative data on products, such as for databases, the test specimens shall be conditioned by storage at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 10) \%$ relative humidity, until constant mass is reached.

5.3 Testing

5.3.1 General

Table 4 gives the dimensions of the test specimens, the minimum number of test specimens required to get one test result and any specific conditions which are necessary.

In the case of pipe sections and prefabricated wares cut from boards, the properties shall be determined on the boards from which they are cut, except dimensions and, where relevant, linearity and squareness.

Table 4 — Test methods, test specimens and conditions

Dimensions in millimetre

Subclause in this document		Test method ^a		Test specimens		Specific conditions
No.	Title	Flat	Pipe section	Dimensions ^b	Minimum number to get one test result	
4.2.1	Thermal conductivity	ISO 8894-1 ISO 8302	ISO 8497	≥ 300 × 300 × <i>t</i> ≥ 200 × 100 × <i>t</i> Full-sized	1 1 1	See Annex C
4.2.2.1	Linear dimensions Length and width Thickness Inside diameter	ISO 29465 ISO 29466	ISO 12628 ISO 12628 ISO 12628	Full-sized Full-sized Full-sized	1 1 1	—
4.2.2.2	Squareness	ISO 29467	ISO 12628	Full-sized	1	—
4.2.2.3	Flatness	ISO 29468	—	Full-sized	1	—
4.2.2.4	Pipe section linearity	—	ISO 12628	Full-sized	1	—
4.2.3	Dimensional stability	ISO 29472	—	Full-sized 500 × 500 × <i>t</i> 250 × 250 × <i>t</i> 200 × 200 × <i>t</i>	1 3 3 3	—
4.2.4	Fire properties	ISO 1182	ISO 1716:2002	—	—	—
4.3.2	Maximum service temperature	ISO 2477	ISO 2477	100 × 100 × <i>t</i>	3	see 5.3.3
4.3.3	Compressive stress or strength	ISO 29469	—	see ISO 29469:2022, 6.1	3	—
4.3.4	Trace quantities of water-soluble ions and the pH-value	ISO 12624	—	—	3	20 g
4.3.5	Water vapour diffusion resistance	ISO 21129	ISO 12629	see ISO 12629	3	see ISO 12629
4.3.6	Short-term water absorption by partial immersion	ISO 29767	ISO 12623	200 × 200 × <i>t</i>	4 4	—

^a All test methods referenced in this table are normative requirements.

^b Full-sized product thickness, except for [4.2.3](#).

5.3.2 Thermal conductivity

The thermal conductivity values shall be determined by the manufacturer and verified in accordance with ISO 13787.

For flat specimens, thermal conductivity shall be based upon measurements carried out in accordance with ISO 8302 or, where necessary for reasons of practicability, ISO 8894-1 (when this method is calibrated against ISO 8302).

For cylindrical specimens, ISO 8497 shall be used.

The tests in accordance with ISO 8497 may be replaced by tests according to ISO 8894-1 or ISO 8302 if it has been demonstrated that the results are safe (higher) values.

The thermal conductivity shall be determined for the full temperature range for the product.

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

The thermal conductivity shall be measured directly at the measured thickness. If this is not possible, it shall be determined by measurements on other thicknesses of the product, if:

- the product is of similar chemical and physical characteristics and is produced on the same production unit;
- it is demonstrated that the thermal conductivity, λ , does not vary more than 5 % over the range of thicknesses where the calculation is applied.

Where a product is manufactured in a range of thicknesses and the manufacturer chooses to characterize the entire range by declaring only one thermal conductivity, λ , the manufacturer shall declare the highest thermal conductivity of the range. In the case of pipe sections, measurements made on two internal diameters of pipe sections at the greatest and smallest insulation thickness for each of the diameters are deemed to be representative of the total product range.

NOTE 1 Suitable sizes are internal diameters of 48 mm and 194 mm.

The guarded hot plate method ISO 8302 or the hot wire methods ISO 8894-1 shall be deemed to be suitable methods for measurement of pipe sections having a diameter exceeding 500 mm. Flat slabs shall be prepared having the same thickness and density as the sections.

NOTE 2 For further guidance on the preparation of test specimens for thermal conductivity, see [Annex C](#).

5.3.3 Maximum service temperature (ST)

5.3.3.1 The maximum ST shall be determined in accordance with ISO 2477, at the declared maximum ST with the exception that the minimum test temperature shall be 650 °C. Specimens for testing the maximum ST of pipe sections and segments may be cut from flat boards with the same composition and density as the pipe section or segment product.

5.3.3.2 The test specimens shall be square cut with a cross-section of 100 mm × 100 mm.

The thickness shall always be product thickness for all applications.

5.3.4 Fire properties

Fire properties with respect to reaction to fire shall be determined in accordance with ISO 1182 and ISO 1716.

6 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 [4.3](#):

— The expanded perlite abbreviated term	EP
— This document number	ISO 6334:2023
— Maximum ST	ST i
— Compressive stress at 5 % deformation or compressive strength	CS (5/Y) i
— Water-soluble chloride level	Cl i
— Water-soluble fluoride level	F i
— Water-soluble sodium level	Na i
— Water-soluble potassium level	K i
— pH-value	pH i
— Water vapour diffusion resistance factor	MU i

where “i” shall be used to indicate the relevant class or level.

The designation code for an EP product is illustrated by the following example:

EP – ISO 6334 – ST 950 – CS (5/Y) 450

7 Evaluation of conformity

The manufacturer or its authorized representative shall be responsible for the conformity of its product with the requirements of this document. The evaluation of conformity shall be carried out in accordance with ISO 12576-1 and shall be based on ITT and 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.

For ITT testing, the λ curve and the maximum and minimum temperature characteristics, only one test result is required using test specimens from four different production dates.

For the evaluation of the conformity of a λ curve over a product full service range, ISO 13787 shall be used.

FPC testing shall be made for the characteristics listed in [Table A.1](#), 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 product or 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 class; specific test conditions shall be indicated with the marking by reference to ML, where relevant;
- declared thermal conductivity: reference to ML, showing thermal conductivity as a function of mean temperature, given as a table, curve or equation;
- declared thickness;
- designation code as given in [Clause 6](#);
- type of facing, if any;
- declared length and declared width or inside diameter, as appropriate;
- 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 in this document		Minimum testing frequency ^a
No.	Title	
4.2.1	Thermal conductivity — at the declared temperature range	once per year ^b
4.2.2	Dimensions and tolerances — length and width — thickness — inside diameter	once per production batch once per production batch once per production batch
4.2.2.2	Squareness	once per production batch
4.2.2.3	Flatness	once per production batch
4.2.2.4	Pipe section linearity	once per production batch
4.2.3	Dimensional stability	ITT ^c and once every 5 years
4.2.4	Fire properties	See 4.2.4
4.3.2	Maximum service temperature (ST)	once per production batch
4.3.3	Compressive stress or strength	once per production batch
4.3.4	Trace quantities of water-soluble chloride, fluoride and the pH-value	ITT ^c and once every 5 years
4.3.5	Water vapour diffusion resistance factor	ITT ^c and once every 5 years
4.3.6	Short-term water absorption	ITT ^c and once every 5 years

^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 Testing once every two years is acceptable, if density is a declared property and the product and process have not changed.

^c For ITT, see ISO 12576-1.

Annex B (informative)

Additional properties

B.1 General

The manufacturer can choose to give information on the following additional properties (see [Table B.1](#)).

This information, where appropriate for the product and the application, should be given as limiting values for each test result obtained from the referred test method, sampling and conditions as given in [Table B.1](#).

B.2 Coefficient of thermal expansion

Coefficient of thermal expansion, if voluntarily declared, shall be determined in accordance with ISO 18099.

B.3 Apparent and true porosity

The apparent and true porosity of expanded perlite products, if voluntarily declared, shall be determined in accordance with ISO 5017.

B.4 Airflow resistance

Airflow resistance, if voluntarily declared, shall be determined in accordance with the ISO 9053 series.

B.5 Creep in compression

Creep in compression, if voluntarily declared, shall be determined in accordance with ISO 20392.

B.6 Permeability to gases

Permeability to gases, if voluntarily declared, shall be determined in accordance with ISO 8841.

B.7 Acoustic properties

Acoustic properties, if voluntarily declared, shall be determined in accordance with ISO 11654.

B.8 Bending strength

Bending strength, if voluntarily declared, shall be determined in accordance with ISO 16537. No test result should be less than the declared level, σ_m , chosen from the following values: 200 kPa, 250 kPa, 300 kPa, 350 kPa, 400 kPa, 450 kPa, 500 kPa, 600 kPa, 700 kPa and 1 000 kPa.

B.9 Density

Apparent density, ρ_a , is a useful identification parameter, but it should not be used as a basis for quality assessment of expanded perlite products. Apparent density of boards should be determined in