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Thermal insulation products — Hemp fiber mat and board — Specification

Produits d'isolation thermique — Panneaux et tapis en fibres de chanvre — Spécifications

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Foreword

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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 products — Hemp fiber mat and board — Specification

1 Scope

This document specifies requirements for factory-made products of hemp fibre, which are used for the thermal insulation of buildings. This document applies to material containing more than 50 % (by mass) natural hemp fibre, with or without the other natural fibre and the balance being polymeric material. The products are delivered as a mat or board with or without facings.

This document describes product characteristics and testing methods, marking, labelling and packaging.

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

The use of moth proof agent residues is outside the scope of this document.

This document does not address the health and safety aspects associated with its use. It is the responsibility of the user of this document to establish appropriate health and safety practices.

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 354, *Acoustics — Measurement of sound absorption in a reverberation room*

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 9229, *Thermal insulation — Vocabulary*

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

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

ISO 12460-1, *Wood-based panels — Determination of formaldehyde release — Part 1: Formaldehyde emission by the 1-cubic-metre chamber method*

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

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

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

3 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
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 production line is considered separately.

3.2
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* (3.1)].

3.3
hemp fibre mat
HFM
soft matted material made from natural hemp fibre as the main (>50 % by mass) material with or without the other natural fibre and the balance being polymeric material.

3.4
hemp fibre board
HFB
plate type products with certain degree of rigidity made from natural hemp fibre as the main (>50 % by mass) material with or without the other natural fibre and the balance being polymeric material.

4 Symbols, units and abbreviated terms

4.1 Symbols and units

b	width, mm
d	thickness, mm
l	length, mm
d_N	nominal thickness of the product, mm
λ	thermal conductivity, W/(m·K)
λ_D	declared thermal conductivity, W/(m·K)
λ_i	Specimen's one test result of thermal conductivity, W/(m·K)
$\lambda_{90/90}$	90 % fractile with a confidence level of 90 % for the thermal conductivity, W/(m·K)
λ_{mean}	Specimens' mean thermal conductivity, W/(m·K)
H	moisture content, %

k factor related to the number of test results available

R_D declared thermal resistance, $m^2 \cdot K/W$

R_i specimen's one test result of thermal resistance, $m^2 \cdot K/W$

R_{mean} mean thermal resistance, $m^2 \cdot K/W$

$R_{90/90}$ 90 % fractile with a confidence level of 90 % for the thermal resistance, $m^2 \cdot K/W$

ρ_a apparent density, kg/m^3

L declared class or level for length tolerances

T declared class or level for thickness tolerances

W declared class or level for width tolerances

4.2 Abbreviated terms and symbols used in designations

HFM hemp fibre mat

HFB hemp fibre board

ITT initial type test

FPC factory production control

5 Requirements

5.1 General

Product properties shall be determined in accordance with Clause 6.

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.

NOTE For FPC, see Annex B.

5.2 Material properties

5.2.1 Thermal resistance and thermal conductivity

For thermal conductivity testing, the specimen shall be conditioned at (23 ± 2) °C and (50 ± 5) % relative humidity to constant mass.

Thermal resistance and thermal conductivity shall be based upon measurements carried out in accordance with ISO 8301 or ISO 8302 for thick products.

The thermal resistance and thermal conductivity shall be determined in accordance with the procedures given in Annex A and declared by the manufacturer according to the following:

— The reference mean temperature shall be either 10 °C or 23 °C, or both.

— The measured values shall be expressed with three significant figures.

— For products of uniform thickness, the thermal resistance, R_D, shall always be declared. The thermal conductivity, λ_D, shall be declared where possible. Where appropriate, for products of non-uniform thickness (i.e. for sloped and tapered products), only the thermal conductivity, λ_D, shall be declared.

— The declared thermal resistance, R_D, and the declared thermal conductivity, λ_D, shall be given as limit values representing at least 90 % of the production, determined with a confidence level of 90 %.

— The value of the thermal conductivity, $\lambda_{D\ 90/90}$, shall be rounded up to the nearest 0,001 W/(m·K) and declared as λ_D in levels with steps of 0,001 W/(m·K).

— The declared thermal resistance, R_D, shall be calculated from the nominal thickness, d_N, and the corresponding thermal conductivity, $\lambda_{90/90}$.

— The value of the thermal resistance, $R_{90/90}$ (when calculated from the nominal thickness, d_N, and the corresponding thermal conductivity, $\lambda_{D\ 90/90}$), shall be rounded down to the nearest 0,05 m^2·K/W and declared as R_D in levels with steps of 0,05 m^2·K/W.

— The value of $R_{90/90}$, for those products for which only the thermal resistance is measured directly, shall be rounded down to the nearest 0,05 m^2·K/W and declared as R_D in levels with steps of 0,05 m^2·K/W.

Determination of declared values of thermal resistance, R_D, and thermal conductivity, λ_D, shall be in accordance within Annex A.

Determination of declared values of thermal conductivity in relation to moisture content shall be in accordance with Annex C.

5.2.2 Length and width

The length, *l*, and width, *b*, shall be determined in accordance with ISO 29465. No test result shall deviate from the nominal values by more than the tolerances given in Table 1 and Table 2.

Table 1 — Products for length tolerances

Product	Tolerances mm
HFM	±5 or ±0,4 %[a]
HFB	±3 or ±0,4 %[a]
[a] Whichever gives the greatest numerical tolerance.	

Table 2 — Products for width tolerances

Product	Tolerances mm
HFM	±2 or ±0,4 %[a]
HFB	±2 or ±0,4 %[a]
[a] Whichever gives the greatest numerical tolerance.	

5.2.3 Thickness

The thickness, *d*, shall be determined in accordance with ISO 29466, under a pressure of 50 Pa. No test result shall deviate from the nominal thickness, d_N, by more than the tolerances given in Table 3.

5.2.4 Service Temperature

Hemp fibre mat (HFB) and hemp fibre board (HFB) thermal insulation shall not be used on a substrate outside a continuous service temperature of −60 °C to +80 °C.

Table 3 — Products for thickness tolerances

Product	Tolerances mm
HFM	+5
	0
HFB	+3
	−2

5.2.5 Reaction to fire

The reaction to fire characteristics of the product as placed on the market shall be measured according to ISO 11925-2.

5.2.6 Moisture content

Moisture content, *H*, shall be determined in accordance with ISO 12570 (80 ± 2 °C). No test result shall exceed a mass fraction of 30 %.

5.3 Specific requirements

5.3.1 Apparent density

Apparent density, ρ_a, is a useful identification parameter. Apparent density of mat and board shall be determined in accordance with ISO 29470. No mean value of a product shall deviate by more than ±15 % from the declared value given in the manufacture's literature.

5.3.2 Sound absorption

Sound absorption coefficient shall be determined in accordance with ISO 354. The sound absorption characteristics shall be calculated in accordance with ISO 11654 using the values for the practical sound absorption coefficient, α_p, at the frequencies 125 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz and 4 000 Hz and the single number value for the weighted sound absorption coefficient, α_w. α_p and α_w shall be rounded to the nearest 0,05 (α_p larger than 1 shall be expressed as $\alpha_p = 1$) and declared in levels with steps of 0,05.

The weighted sound absorption coefficient, α_w, shall be declared. No result of α_w shall be lower than the declared level.

5.3.3 Formaldehyde release

The formaldehyde release amount shall be measured and declared according to ISO 12460-1. The formaldehyde release shall be declared.

6 Test methods

6.1 Sampling

Test specimens shall be taken from the same sample with a total area not less than 1 m^2 and sufficient to cover the needed tests. The shorter side of the sample shall not be less than 300 mm or full size of the product, whichever is the smaller.

6.2 Conditioning

Condition the test specimen at (23 ± 2) °C and (50 ± 5) % relative humidity or (27 ± 5) °C and (65 ± 5) % relative humidity for 6 h.

For thermal conductivity testing, the conditioning shall be according to 5.2.1.

6.3 Procedure

6.3.1 General

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

The test may be performed on the faced product, if the facing is known to have no relevance to the test result.

Table 4 — Test methods, test specimens and specific conditions

Sub-clause		Test method	Test specimen length and width (mm)	Minimum number of specimens for one test result	Specific conditions	Material requirements
No.	Title					
5.2.1	Thermal resistance and thermal conductivity	ISO 8301 or ISO 8302	Required in ISO 8301 or ISO 8302	3	(23 ± 2) °C and (50 ± 5) % relative humidity to constant mass.	Declared
5.2.2	Length and width	ISO 29465	Full-size	3	-	Table 1 and Table 2
5.2.3	Thickness	ISO 29466	Full size	3	Method in Annex B; pressure at 50 Pa	Table 3
5.2.4	Reaction to fire	ISO 11925-2	250 x 90	6	-	Declared
		EN 13823	1 500 ×1 000 1 500 × 495	3	-	Declared
5.2.5	Moisture content	ISO 12570	200 × 200	3	(80 ± 2) °C to constant mass	30 % maximum
5.3.1	Apparent density	ISO 29470	Full size	3	(23 ± 2) °C and (50 ± 5) % relative humidity to constant mass	Declared

Table 4 *(continued)*

Sub-clause		Test method	Test specimen length and width (mm)	Minimum number of specimens for one test result	Specific conditions	Material requirements
No.	Title					
5.3.2	Sound absorption	ISO 354	10 m^2 minimum	3	-	Declared in steps of 0,05
5.3.3	Formaldehyde release	ISO 12460-1	Required in ISO 12460-1	3	-	Declared

6.3.2 Thermal resistance and thermal conductivity

For thermal conductivity testing, the specimen shall be conditioned (23 ± 2) °C and (50 ± 5) % relative humidity to constant mass.

Thermal resistance and thermal conductivity shall be determined in accordance with ISO 8301 or ISO 8302 for thick products and under the following conditions:

— at a mean temperature of (10 ± 0,30) °C or at a mean temperature of (23 ± 0,30) °C.

Thermal resistance and thermal conductivity can also be measured at other mean temperatures, providing that the accuracy of the relationship between temperature and thermal properties is well documented.

Thermal resistance and thermal conductivity shall be determined directly at measured thickness. In the event that this is not possible, they shall be determined by measurements on other thicknesses of the product providing that

— the product is of similar chemical and physical characteristics and is produced on the same production unit, and

— it can be demonstrated that the thermal conductivity, λ, does not vary more than 2 % over the range of thicknesses where the calculation is applied.

When measured thickness is used for testing of thermal resistance and 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 gabs during testing.

Determination of declared values of thermal conductivity in relation to moisture content $^{\lambda}$ shall be in accordance with Annex C.

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 5.3:

— the hemp fibre mat and hemp fibre board abbreviated term, HFM and HFB;

— this document number, i.e. ISO 24260:2022;

— thickness, d_N;

— width and length, *b* and *l*;

— thermal resistance and/or thermal conductivity, λ_D and/or R_D.

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

EXAMPLE HFM — ISO 24260 — d_N90 — b395 —l10600, λ_D 0,044 W/(m·K), R_D 2,05 (m^2·K/W)

NOTE The characteristics determined in 5.2 are not included in the designation code if a limit value (threshold value) is given for the product.

8 Product conformity

8.1 General

The manufacturer shall be responsible that the product conforms the requirements of this document. The evaluation of conformity shall be carried out in accordance with ISO 12576-1 System 3 and shall be based on initial type testing (ITT), factory production control (FPC) by the manufacturer, including product assessment, and tests on samples taken at the factory.

Conformity of the product with the requirements of this document and with the stated values (including classes) shall be demonstrated by choosing the required system from ISO 12576-1 and include the following:

— ITT;

— FPC by the manufacturer, including product assessment. Grouping products is possible if a valid demonstration of the relation between products is given.

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

8.2 Initial type testing (ITT)

All characteristics defined in 5.2 and those in 5.3, if declared, shall be subject to ITT in accordance with Annex B.

8.3 Factory production control (FPC)

The minimum frequencies of tests in the FPC shall be in accordance with Annex B. When indirect testing is used, the correlation to direct testing shall be established in accordance with ISO 12576-1.

9 Marking and labelling

Products conforming to this document shall be marked clearly, 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 authorized representative;

— shift or time of production or traceable code;

— reaction to fire performance of the product as placed on the market in accordance with the test methods specified in 5.2.4 and additionally required national or regional test and classification methods;

— declared thermal resistance (R_D);

— declared thermal conductivity (λ_D);

— nominal thickness (d_N);

— designation code as given in Clause 7;

— nominal length;

— nominal width;

— type of facing, if any;

— number of pieces and area in the package, as appropriate;

— the products shall be protected from rain during storage.

Annex A
(normative)

Determination of the declared values of thermal resistance and thermal conductivity

A.1 General

It is the responsibility of the manufacturer to determine the declared values of thermal resistance and thermal conductivity and to demonstrate conformity of the product to its declared values. The declared values of thermal resistance and thermal conductivity of a product are the expected values of these properties during an economically reasonable working life under normal conditions, assessed through measured data from the specimens, which are conditioned in (23 ± 2) °C and (50 ± 5) % relative humidity to constant weight.

A.2 Input data

In order to calculate the declared values, the manufacturer shall have at least 10 test results for thermal resistance or thermal conductivity, obtained from internal or external direct measurements. These measurements shall be carried out at regular intervals, spread over a period of the last 12 months. If fewer than 10 test results are available, that period may be extended until 10 results are obtained, but in a maximum period of three years, within which the product and production conditions have not changed significantly.

For new products, the 10 thermal resistance or thermal conductivity test results shall be obtained spread over a minimum period of 10 days.

The declared values shall be calculated according to the method given in A.3 and shall be recalculated at intervals not exceeding three months of production.

A.3 Declared values

A.3.1 General

The derivation of the declared values, R_D and λ_D, from the calculated values, $R_{90/90}$ and $\lambda_{90/90}$, shall use the rules given in 5.2.1 which include the rounding conditions.

A.3.2 Case where both thermal resistance and thermal conductivity are declared

The declared values, R_D and λ_D, shall be derived from the calculated values, $R_{90/90}$ and $\lambda_{90/90}$, which are determined using Formula (A.1), Formula (A.2) and Formula (A.3).

$$\lambda_{90/90} = \lambda_{mean} + k \times S_\lambda \tag{A.1}$$

$$S_\lambda = \frac{\sum_{i=1}^{n} (\lambda_i - \lambda_{mean})^2}{n-1} \tag{A.2}$$

$$R_{90/90} = d_N/\lambda_{90/90} \quad (A.3)$$

Values for k shall be taken from Table A.1.

A.3.3 Case where only thermal resistance is declared

The declared value, R_D, shall be derived from the calculated value, $R_{90/90}$, which is determined using Formula (A.4) and Formula (A.5).

$$R_{90/90} = R_{mean} - k \times S_R \quad (A.4)$$

$$S_R = \frac{\sum_{i=1}^{n}(R_i - R_{mean})^2}{n-1} \quad (A.5)$$

Values for k shall be taken from Table A.1.

Table A.1 — Values for *k* for a one-sided 90 % tolerance interval with a confidence level of 90 %

Number of test results	k[a]
10	2,07
11	2,01
12	1,97
13	1,93
14	1,90
15	1,87
16	1,84
17	1,82
18	1,80
19	1,78
20	1,77
22	1,74
24	1,71
25	1,70
30	1,66
35	1,62
40	1,60
45	1,58
50	1,56
100	1,47
300	1,39
500	1,36
2 000	1,32

[a] For other values of test results, use ISO 12491 or linear interpolation.

Annex B
(normative)

Factory production control (FPC)

Table B.1 — Minimum product testing frequencies

Subclause		Minimum testing frequencies[a]		
No.	**Title**	**Direct testing**	**Indirect test method**	**Testing frequency**
5.2.1	Thermal resistance and thermal conductivity	1 per 3 months and indirect testing	Apparent density	1 per 2 h
5.2.2	Length and width	1 per 2 h	—	—[b]
5.2.3	Thickness	1 per 2 h		—[b]
5.2.4	Reaction to fire	ISO 11925-2, 1 per week; EN 13823,1 per 2 years and indirect testing	Manufacturer's method	1 per day
5.2.5	Moisture content	1 per week and indirect testing	Manufacturer's method	1 per day
5.3.1	Apparent density	Once per production batch	—	—[b]
5.3.2	Sound absorption	1 per 5 years	Apparent density and thickness	1 per 2 h

[a] The minimum testing frequencies, expressed in test results, shall be understood as the minimum for each production unit/line under stable conditions. In addition to the testing frequencies given above, testing of the relevant properties of the product shall be repeated when changes or modifications are made that are likely to affect the conformity of the product.

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

[b] Frequencies are not given, as test methods are not available.