INTERNATIONAL STANDARD

ISO 8145

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Thermal insulation — Mineral wool board for overdeck insulation of roofs — Specification

Isolation thermique — Panneaux rigides en laine minérale pour l'isolation par l'extérieur des toitures-terrasses — Spécifications

Reference number
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Contents

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8145 was prepared by Technical Committee ISO/TC 163, *Thermal insulation*, Sub-Committee SC 3, *Insulation products for building applications*.

Annexes A, B, C, D and E form an integral part of this International Standard. Annexes F, G and H are for information only.

Thermal insulation — Mineral wool board for overdeck insulation of roofs — Specification

1 Scope

This International Standard specifies the properties and acceptable tolerances for bonded man-made mineral wool board for the overdeck insulation of roofs of buildings. The product is intended for roofs carrying foot traffic by maintenance personnel only (for examples of intended uses, see ISO/TR 9774, figure 1, sketches 7 and 9).

The properties to be declared by the manufacturer at the time of delivery are specified, as are some test methods for the determination of these properties. Caution should be exercised in using test results as design values.

This International Standard provides limiting values for most of the properties. These limiting values are for specification purposes only, design values may be derived from these by taking into account the environmental factors affecting the thermal performance of the product, the influence of the product properties on installation, and the effect of workmanship on the thermal performance. For converting declared R or λ values to design values, see, for example, ISO/TR 9165.

It applies to board with or without a membrane for the insulation of the upper surface of roofs under roofing systems protected against water. The properties of a facing membrane are not described. When the board is supplied with a facing membrane, it is not intended to be waterproof.

The board is intended to be fixed to the roof surface. When boards are fixed mechanically, some modification of the specified mechanical properties may be necessary.

The sampling and conformity control plan described in annex F and the certification procedure described in annex G are recommendations only.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7345:1987, *Thermal insulation — Physical quantities and definitions.*

ISO 8301:1991, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus.*

ISO 8302:1991, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus.*

ISO/TR 9165:1988, *Practical thermal properties of building materials and products.*

ISO/TR 9774:1990, *Thermal-insulation materials — Application categories and basic requirements — Guidelines for the harmonization of International Standards and other specifications.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 bonded mineral wool insulation: Vitreous fibres having a woolly consistency made from rock, slag or glass and bonded with a suitable binder.

3.2 board: Rigid insulation product of rectangular shape with or without a facing with the thickness significantly smaller than the other dimensions.

NOTE 1 A common method for checking the suitability of the binder in the insulation boards is the measurement of interlaminar strength, and deformation under compression, before and after treating the product with both temperature and moisture.

4 Sampling and conformity control

For the purposes of sampling and conformity control by inspection lots, the procedures described in annex F are recommended.

In plants where different product types are manufactured on the same production line within short intervals as regards time and quantity, it is recommended that production be subjected to a third-party certification system as described in annex G.

NOTE 2 Annexes F and G, which are not an integral part of this International Standard, provide some possible procedures for attestation of conformity which have to be agreed between the manufacturer and the consumer. A general International Standard on the procedure of attestation of conformity for all thermal insulation products is under preparation and will replace the common causes of these annexes.

5 Required properties

5.1 Dimensions

The manufacturer shall declare the nominal length, width and thickness of the board.

These dimensions shall be measured in accordance with annex A and shall be subject to the tolerances detailed in table 1. Tighter tolerances can be necessary for certain applications; these shall be agreed to between the supplier and purchaser.

5.2 Fire behaviour

These insulation materials with or without a membrane shall meet with the fire regulations and codes that apply in the locality in which they are applied.

5.3 Thermal transmission properties

The thermal transmission properties of a product shall be declared by the manufacturer as either thermal resistance, R, or thermal conductivity, λ. (See ISO 7345.) The mean test temperature shall also be declared.

R or λ shall be determined in accordance with annex E (see also ISO 8301 or ISO 8302), and shall be subject to the tolerances given below.

Table 1 — Dimensional tolerances

Dimension	Permissible deviations of measured values from nominal dimensions	Test method
Length, l	± 5 mm or ± 1 % whichever is the greater on average of measured values for each single specimen.	Clause A.1
Width, b	± 5 mm on average of measured values for each single specimen.	Clause A.1
Thickness, d	± 3 mm on average of measured values for all specimens tested.	Clause A.2
Squareness	For each 1 000 mm of the longest face dimension, the maximum deviation shall be not more than 3 mm. The edge plane of the thickness dimension of the board shall be not more than 3 mm out of square.	Clause A.3
Flatness	The maximum deviation shall be not more than 0,40 % of the length or width as appropriate.	Clause A.4

Thermal transmission properties may be measured directly or they may be determined from measurements on other thicknesses of the material, provided that:

a) the material is of the same quality (density, fibre diameter and distribution, etc.) and is produced on the same production line;

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

The thermal conductivity shall be less than or equal to the manufacturer's declared values.

The thermal resistance shall be greater than or equal to 95 % of the manufacturer's declared values.

NOTES

3 The apparent discrepancy between the requirements for thermal conductivity compared to thermal resistance arises from the negative tolerance on thickness permitted in table 1.

4 Because of the differences in manufacturing processes, one manufacturer can have the same thermal resistance but at a slightly different thickness and/or density to that produced by some other manufacturer.

5.4 Deformation resistance

When measured in accordance with annex B, average deformation shall not be greater than 10 % after maintaining the load of 20 kPa for 24 h at 23 °C. Additional deformation shall not be greater than 5 % after maintaining the load of 20 kPa for an additional 24 h at 80 °C.

5.5 Interlaminar strength

When tested in accordance with annex C, the strength shall be greater than or equal to 7,5 kPa.

If, for special conditions, higher values are required, this shall be agreed upon between the supplier and the purchaser.

5.6 Breaking load

When tested in accordance with annex D, the breaking load shall be greater than 80 N in both directions.

5.7 General properties

5.7.1 There are no test procedures specified for the following requirements. However, for the requirements in 5.7.2, visual inspection is recommended.

For the requirements in 5.7.3 and 5.7.4, the manufacturer should be consulted.

5.7.2 The insulation material shall be free of extraneous and coarse material and the fibre shall be distributed evenly.

5.7.3 The insulation material shall not sustain the growth of fungus.

5.7.4 The insulation material shall not accelerate the corrosion of metallic surfaces with which it comes into contact in normal use.

6 Marking

Mineral wool insulation boards shall be delivered with the following information marked on the product or the package:

a) the manufacturer's name and product designation;

b) manufacturing origin (location);

c) type of facing (if any);

d) production code;

e) nominal length, width, thickness and area of insulation in the package;

f) nominal R value or nominal λ value and mean temperature;

g) additional markings, as required by national regulations of countries where the product is to be used, such as design values for R or λ, reaction to fire and safety and health information;

h) reference to this International Standard.

7 Test report

The test report shall be prepared by the laboratory that conducted the test and shall include the following information:

a) the manufacturer's name and product designation;

b) the type of product and other description about facing and type;

c) nominal dimensions;

d) production code;

e) information about sampling;

f) the manufacturer's declared R value or λ value and corresponding mean temperature;

g) report of all test results including maximum or minimum values;

h) comparison of test results and assessment with the manufacturer's claim and the requirements of this International Standard;

i) statement of conformity with this International Standard;

j) name and location of laboratory carrrying out the tests.

Annex A
(normative)

Determination of dimensions of boards

A.1 Determination of length and width

A.1.1 Measuring device

A steel tape graduated in millimetres shall be used as a measuring device.

A.1.2 Specimens

Every board in a package but not more than five boards shall be tested.

A.1.3 Procedure

Lay the full board on a flat surface and measure its dimensions as follows.

Place the steel tape (A.1.1) across the surface of the full board parallel to one edge and at right angles to the adjacent edge.

Take measurements at two positions on one face for length l, and three positions on one face for width b, as shown in figure A.1.

Measurements shall be read to the nearest 1 mm.

The length and width recorded shall be the mean of those measurements of each board.

Note the results in the test report.

A.1.4 Test report

The test report shall indicate the mean of the measured values for length and for width, for each single specimen.

A.2 Determination of thickness

A.2.1 Measuring device

The measuring device may consist of the following parts, as shown in figure A.2:

a) a **dial gauge**, graduated in 0,1 mm, suitably mounted on a rigid frame fastened to a flat rigid base plate which is approximately 300 mm square;

b) a **circular flat foot** 200 mm in diameter at the lower end of the dial gauge rod which together exert a total pressure on the specimen of 0,1 kPa.

NOTE 5 Any other suitable apparatus is acceptable provided it is capable of applying a pressure of 0,1 kPa on a disc of the same diameter.

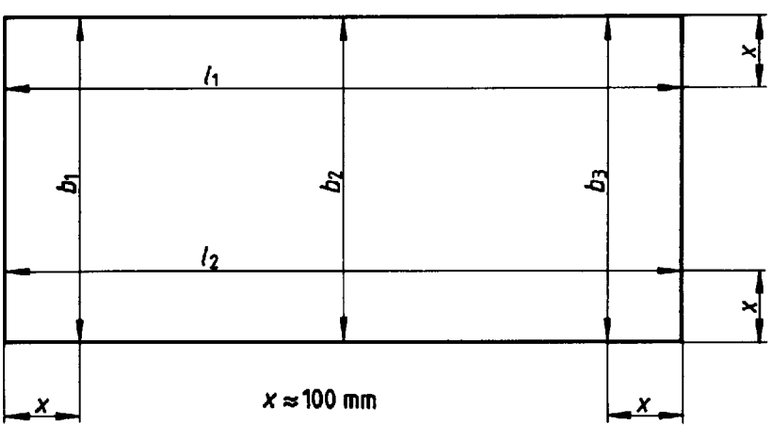

Figure A.1 — Location of measurements for length and width

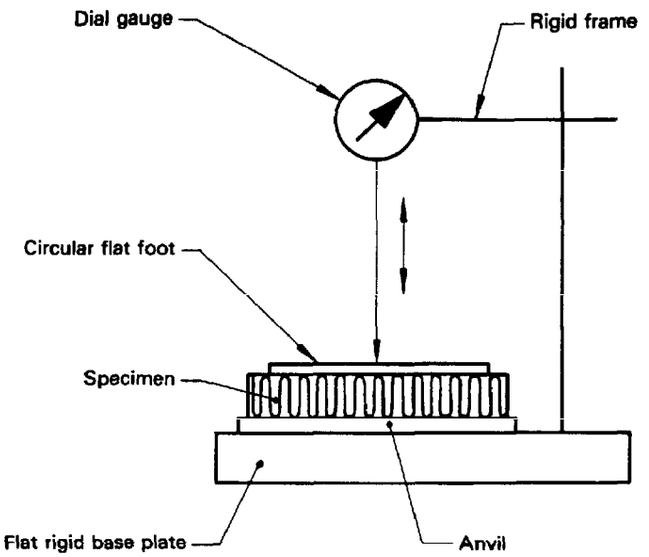

Figure A.2 — Example of suitable apparatus for determination of thickness

A.2.2 Sample

Every board in a package but not more than five boards shall be tested.

A.2.3 Procedure

Take measurements d_1 and d_2 at the two positions marked D_1 and D_2 on the board surface, as shown in figure A.3.

Place the specimen between the anvil and the circular flat foot. Lower the circular flat foot until it is resting freely on the specimen at a marked position. The edge of the foot shall not extend over the edge of the specimen.

The dial gauge shall be read to the nearest millimetre.

Note the results in the test report.

A.2.4 Test report

The test report shall give the following information:

a) each measured value and the mean of the two readings d_1 and d_2 as the specimen thickness;

b) the mean of all the specimen thicknesses as the sample thickness.

A.3 Determination of squareness

A.3.1 Principle

Determination of the deviation from squareness for width and thickness for a full board.

A.3.2 Measuring device

A steel square with limbs at least 500 mm in length and a steel tape graduated in millimetres shall be used as measuring devices.

A.3.3 Specimens

Every board in a package but not more than five boards shall be tested.

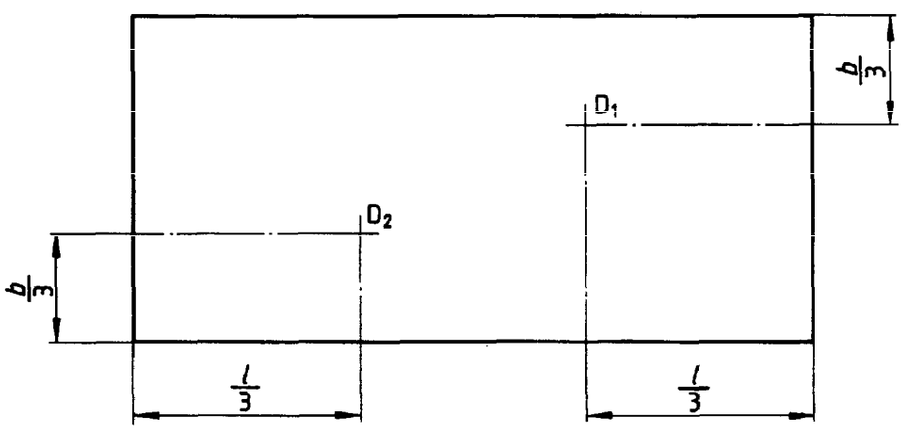

Figure A.3 — Locations for thickness measurements

A.3.4 Procedure

Lay the full sheet or board on a flat surface and measure the deviation from squareness of the thickness and width as follows.

A.3.4.1 Thickness deviation

Place the steel square on the flat surface against one end of the board as in figure A.4. Measure the distance, a, to the nearest 1 mm, between the edge corner of the board and the edge of the square at the point of greatest deviation. Note this distance, which is the deviation from squareness, in millimetres. Repeat for all four corners of the board. Repeat the whole operation for each specimen. Record the average deviation of each board.

A.3.4.2 Width deviation

Place the steel square along one of the parallel sides of the insulation with the right angle of the square aligned against the adjoining edge as in figure A.5.

Measure the distance, a, to the nearest 1 mm, between the edge of the board and the edge of the square at the point of greatest deviation. Note this distance, which is the deviation from squareness, in millimetres per 1 000 mm of width. Repeat for all four corners of the board. Repeat the whole operation for each specimen. Record the maximum deviation for each specimen.

A.3.5 Test report

A.3.5.1 Squareness on thickness

The test report shall indicate the mean deviation from squareness in millimetres, for each specimen.

A.3.5.2 Squareness on width

The test report shall indicate the maximum deviation from squareness in millimetres per 1 000 mm, for each specimen.

A.4 Determination of flatness

A.4.1 Principle

Determination of the flatness of a board by measuring local flatness deviations using a straightedge.

A.4.2 Measuring devices

A rigid straightedge, 150 mm longer than the board, a steel tape or ruler graduated in millimetres and two identical wooden blocks with planed surfaces about 100 mm in length, and about 25 mm wide and of the same thickness, y, shall be used as measuring devices.

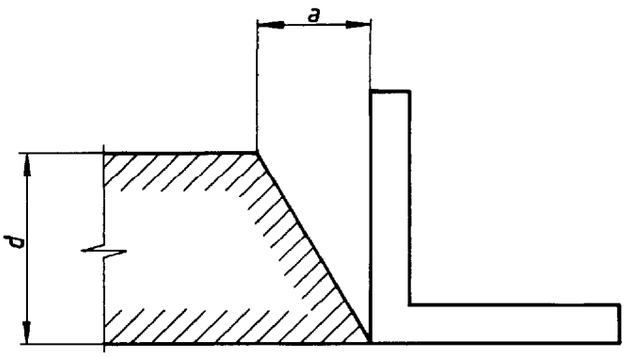

Figure A.4 — Deviation from squareness for thickness

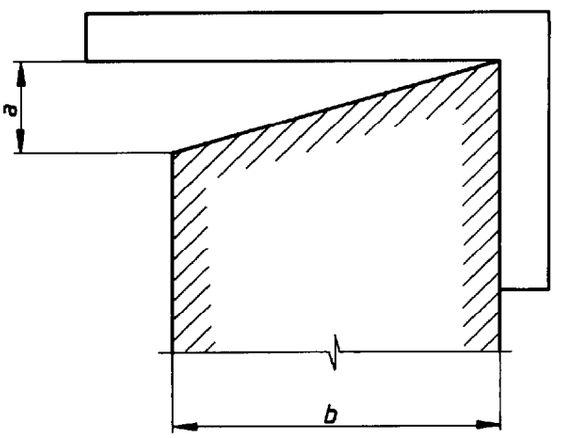

Figure A.5 — Deviation from squareness for width

A.4.3 Specimens

Every board in a package but not more than five boards shall be tested.

A.4.4 Procedure

See figure A.6.

A.4.4.1 Lay each insulating board on a flat surface with the convex face upwards. Place the wooden blocks or fillets of equivalent hardness and known thickness, y, on the board surface, flush with the edges and located midway along the edge.

Using the steel tape or ruler, measure the maximum distance, to the nearest 1 mm, from the underside of the straightedge to the board surface, x.

The local flatness deviation is the distance x-y.

A.4.4.2 Repeat the procedure of A.4.4.1 for each specimen in the direction at right angles to the first line.

A.4.4.3 Record all measurements taken on the specimens.

A.4.4.4 The local flatness deviation of each specimen is divided by length or width as appropriate to determine which is the greater.

A.4.5 Test report

The test report shall indicate all x-y values for each specimen and the maximum deviation for each specimen.

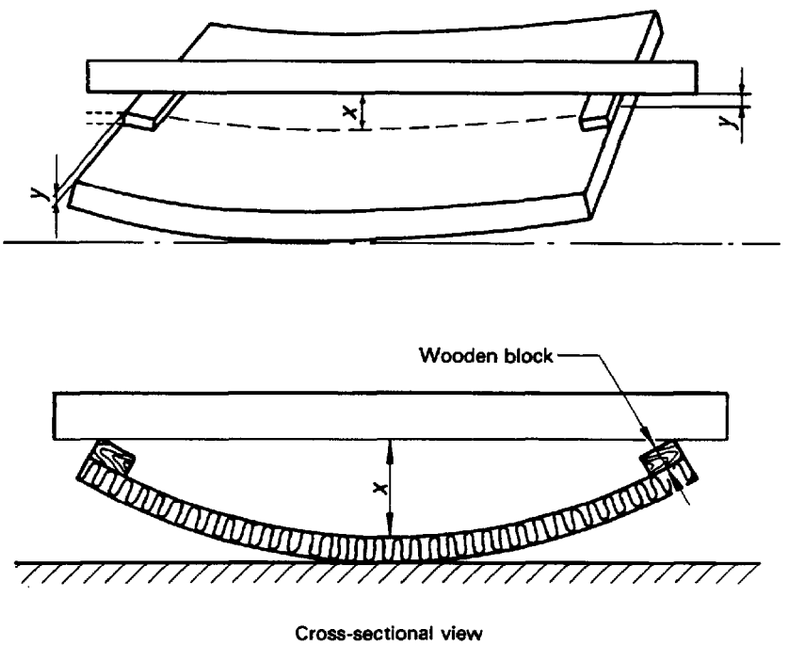

Figure A.6 — Measurement of local flatness

Annex B
(normative)

Determination of deformation resistance

B.1 Principle

Determination of the resistance of a board to deformation when loaded at temperatures encountered in service.

B.2 Apparatus

B.2.1 Suitable test device to apply specific loads for a duration of time.

B.2.2 Air-ventilated oven in which the temperature can be kept constant within ± 2 °C.

B.3 Specimens

Three test specimens shall be cut. They may be taken from the same board, avoiding any obviously damaged areas.

These shall be at least 100 mm × 100 mm × full board thickness, and not greater than 300 mm × 300 mm × full board thickness.

The densities of the specimens should be representative of the product.

Products with membranes may be tested with membranes attached; if the product fails, remove the membrane and repeat the test.

B.4 Procedure and calculation

B.4.1 Determine the initial thickness, d_1, at a loading corresponding to 0,1 kPa.

B.4.2 Load the specimens uniformly to a value equivalent to 20 kPa at a temperature of 23 °C ± 2 °C and a relative humidity within the range 50 % to 70 %.

Maintain the loading for 24 h.

Determine the thickness under load, d_2, at the end of 24 h.

B.4.3 Calculate and record the change in thickness, Δd, expressed as a percentage, at 23 °C using

$$\Delta d = \frac{d_1 - d_2}{d_1} \times 100$$

B.4.4 Raise the temperature to 80 °C ± 2 °C and maintain the loading for 24 h at 20 kPa.

Determine the thickness, d_3, under this load at the end of 24 h.

B.4.5 Calculate and record the change in thickness, $\Delta d'$, expressed as a percentage, at 80 °C using

$$\Delta d' = \frac{d_2 - d_3}{d_2} \times 100$$

B.5 Test report

The test report shall indicate the mean percentage change in thickness at 23 °C and 80 °C as the deformation resistance of a board.

Annex C
(normative)

Determination of interlaminar strength

C.1 Principle

Determination of the transverse load per unit area required to fracture a board.

C.2 Apparatus

The apparatus consists of

— five pairs of **flat rigid plates** at least 200 mm × 200 mm: plates shall be adequately rigid so that the specimen is not subject to any deformation during test;

— **suitable test device** with crosshead speed 10 mm/min;

— **suitable adhesive**, e.g. asphalt or equivalent;

— **device for cutting specimens**.

C.3 Specimens

The test samples shall comprise five specimens of dimensions 200 mm × 200 mm × full board thickness, evenly or unevenly spaced across the board. No specimen shall be taken within 50 mm of the edge.

C.4 Procedure

Carefully cement each test specimen between plates as shown in figure C.1. Apply only enough pressure to ensure complete surface contact. Some surface sanding of the sample can be required to provide good contact.

Carefully align the centre of both plates and specimen in the perpendicular direction. Apply the load perpendicular to the specimen surface at a crosshead speed of 10 mm/min and record the maximum load obtained during the test.

Note and record how the material failed or the facing membrane delaminated. Discard any samples where the specimen failed in the adhesive layer.

Calculate and record the mean load, in kilopascals, for the five specimens.

C.5 Test report

The test report shall indicate the interlaminar strength of a board, in kilopascals, as the mean of the test results of five specimens expressing the loads.

Dimensions in millimetres

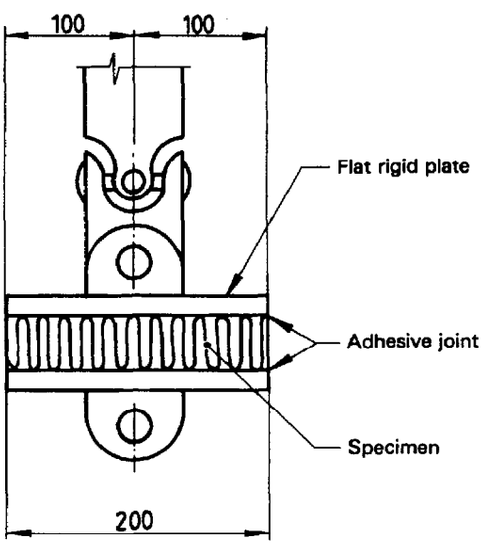

Figure C.1 — Interlaminar strength test

Annex D
(normative)

Determination of breaking load

D.1 Apparatus

The apparatus consists of

— any form of a **standard test machine** applying and indicating the required load within an accuracy of 2 %,

— **cylindrical bearing cylinders** 30 mm ± 5 mm in diameter; they shall be straight and self-aligning so as to maintain full contact with the specimen throughout the test. They shall be placed so that there is no contact between the specimen and the base plate during the test and shall have a length at least equal to the width of the specimen and shall be placed so as to provide a span of 250 mm.

NOTE 6 For board thicknesses greater than 50 mm, the distance between the bearing edges should be a distance equal to five times the specimen thickness.

D.2 Specimens

Six specimens, which may be taken from the same board, shall be cut, three in the machine direction and three in the cross machine direction, evenly or unevenly spaced across the board.

These specimens shall be 300 mm long × 150 mm wide × full board thickness. They shall not be cut closer than 50 mm to the edge of the board.

The density of the specimens shall be representative of the product.

D.3 Procedure

Measure and record the width, length and thickness of each specimen to the nearest millimetre.

Place a specimen flat, and lengthwise on the bearing edges, with the facing, if any, upwards.

Apply the load perpendicularly to the specimen surface at a rate of 10 mm/min (see figure D.1).

Record the maximum load in newtons.

Calculate and record the mean of the three breaking loads for each direction.

D.4 Test report

The test report shall indicate the mean breaking load of the specimens in both directions as the breaking load for the board.

Dimensions in millimetres

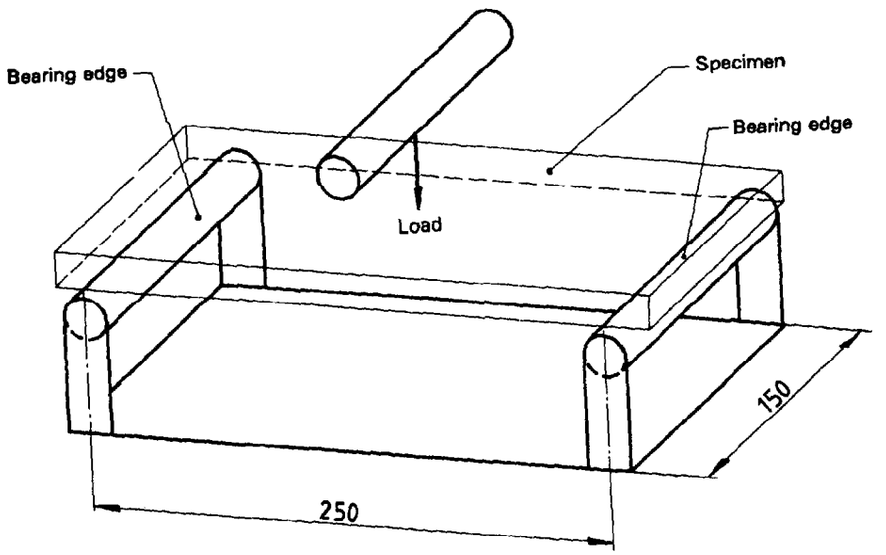

Figure D.1 — Breaking load test apparatus

Annex E
(normative)

Determination of thermal transmission properties

E.1 General

Thermal transmission properties shall be determined in accordance with ISO 8301 (heat flowmeter) or ISO 8302 (guarded hot plate). In case of dispute, the guarded hot plate method shall be used.

The heat flowmeter or guarded hot plate are used to measure the areal density of heat flowrate and temperature difference. The thermal resistance, R, of the test specimen is derived directly from them. Thermal conductivity, λ, may be derived from these figures and the thickness of the test specimen; then the R value for other thicknesses may be calculated. The relationship between thermal resistance, R, in square metres kelvin per watt, and thermal conductivity, λ, in watts per metre kelvin, at a given thickness, d, in metres, is given by the following equations:

$$\lambda = \frac{d}{R}$$

$$R = \frac{d}{\lambda}$$

For λ of the test specimen at thickness d, the thickness tested is to be inserted.

E.2 Specimens

From each sample, two specimens shall be cut out of the board or test piece on which thickness measurements have been made.

Before testing, the specimens shall be

— oven-dried to constant mass; or

— conditioned in a room at 23 °C ± 2 °C and a humidity less than 50 % R.H. to constant mass.

When the sample is very thick and its thermal properties cannot be measured by guarded hot plate apparatus or heat flowmeter, specimens with the thickness available may be used, provided that:

a) the material is of the same quality (density, fibre diameter and distribution, etc.) and is produced on the same production line;

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

The thermal transmission properties of faced material may be measured including the facing unless that facing affects the test results appreciably.

E.3 Procedure

The following procedure shall be used:

a) measure the thickness of the specimens in accordance with A.2.3;

b) measure the thermal resistance, R, or the thermal conductivity, λ, in accordance with ISO 8301 or ISO 8302: use the measured thickness of the specimen;

c) conduct the tests at a mean temperature of either 23 °C or 10 °C (in tropical countries a mean temperature of 40 °C may be agreed upon), and a temperature difference of at least 20 °C;

d) calculate λ value from measured values of R and d;

e) calculate the mean values of λ for all specimens;

f) calculate mean R value using mean λ value and mean measured thickness of all the specimens.

E.4 Test report

The test report shall include the following information:

a) test thickness d of specimens;

b) λ and R values of each specimen;

c) mean λ and R values;

d) mean temperature at which the transmission properties were determined.

Annex F
(informative)

Sampling and conformity control

F.1 General

This annex recommends certain rules for the conformity control of mineral wool boards, as for control systems, lot sampling and conformity criteria.

The purpose of this annex is to provide uniform methods to be used in determining whether a consignment of mineral wool boards should be accepted as conforming to the requirements of this International Standard. It may be applied on agreement between manufacturer and purchaser in absence of regulations in the locality where the insulation is used.

F.2 Definitions

For the purposes of this annex, the following definitions apply.

F.2.1 consignment: Quantity of packages or boards of the same category delivered at one time. The consignment may consist of one or more inspection lots or parts of an inspection lot.

F.2.2 inspection lot: Definite quantity of packages (boards) manufactured under conditions which are presumed uniform, and that are submitted for inspection and accepted or rejected as a whole, depending on the quality found by inspection of the sample drawn from the lot.

F.2.3 sample: One or more items taken from an inspection lot intended to provide information on the lot and possibly to serve as a basis for decision on the lot, the items of the sample being selected at random without regard to their quality. The number of items of the product in the sample is the sample size.

F.2.4 test specimen: Single item or part of an item used for a test.

F.2.5 sampling plan: Plan according to which sample size, frequency of testing, etc., is defined, in order to obtain information and possibly to reach a decision for conformity control purposes.

F.2.6 factory quality control: All control measures by the manufacturer (process control) necessary to maintain and regulate the quality of the current production in conformity with specified requirements.

F.2.7 conformity control: Performance of control methods to prove whether a product can be accepted as conforming to specified requirements.

F.2.8 acceptance testing: Tests to be carried out to prove whether a product can be accepted as conforming to specified requirements.

F.2.9 lot testing: System under which a lot, represented by a specified number of items of the product, is tested and the result used to judge the measure of conformity with the specification. The judgment is on the lot and not on the ongoing production as a whole.

F.2.10 manufacturer's declaration of conformity: Action by which a manufacturer declares under his own responsibility, by means of a "declaration of conformity", that the product is in conformity with the specification, without being under procedures of a third-party certification system.

F.2.11 certification of conformity: Delivery of a document issued by a third party independent of the manufacturer that the product is in conformity with the specification.

F.2.12 verification: Validation by a third party, independent of the manufacturer, of the manufacturer's declaration of conformity.

F.3 Conformity control systems

Conformity control may be checked according to one of the following systems:

a) **Type I**

Lot testing on the consignment by the purchaser's representative or a third party independent of the manufacturer. It may be agreed between manufacturer and purchaser that lot testing is only to be performed in case of dispute.

b) **Type II**

Certification or verification by a third party independent of the manufacturer that the production is under manufacturer's quality control and that the results of the quality control tests comply with the specified properties of the product; in addition, the

third party performs tests on samples out of the production to verify the results of the manufacturer's quality control testing.

These samples may be taken out of the current production, despatch store, warehouse, etc. Whether certification or verification is used may depend on the legal situation in the locality of production.

c) **Type III**

Manufacturer's declaration of conformity by which the manufacturer verifies that his production is under quality control and that the results of the quality control tests comply with the specified properties of the product (see ISO/IEC Guide 22).

For conformity control systems II and III, inspection by attributes or inspection by variables may be applied; for conformity control system I, only inspection by attributes is recommended.

The conformity or nonconformity is judged on the basis of the conformity criteria. Conformity leads to acceptance, while nonconformity may lead to further actions, which shall be agreed upon between manufacturer and purchaser.

F.4 Inspection lot and sampling plan

F.4.1 General

F.4.1.1 Inspection lot

The inspection lot shall consist of mineral wool mats of the same nominal quality, density, fibre distribution, binder, etc. which are produced under the same conditions on the same plant, at the same production line and in a limited time period.

The inspection lot should not be smaller than 1 500 m^2 insulation area[1)], but it should not cover more than the production of one week.

An inspection lot may consist of one or more homogeneous consignments, if they were produced under equal conditions. Products differing only by the kind of facing or the dimensions may be taken in the same inspection lot, if the different properties do not affect the test results by more than 2 %.

F.4.1.2 Sampling

A sample may consist of one or several items. The item shall be one package of boards.

The items shall be taken out of the inspection lot at random without regard to their quality at the sampler's discretion.

The samples shall be marked so that there is no possibility of error. The sampler shall prepare a record of the sampling procedure. The place where the sample is to be taken depends on the type of conformity control:

— for type I they may be taken from the despatch store or from the delivery vessel (truck, ship, etc.);

— for types II and III they shall be taken from current production.

F.4.2 Sampling plan

The sample size (i.e. number of items for one sample), taking into account the lot size and the type of conformity control, is given in table F.1.

The sample size for the type I system is specified on condition that no previous information is available as a result of the manufacturer's quality control.

If additional lots taken from batches which have already been tested in accordance with systems of types II or III, the results of which are known, are tested using lot testing, e.g. in case of doubt or by agreement between manufacturer and purchaser, the size of the lot shall be that given in table F.1 for types II and III.

For subsequent revisions of this International Standard, the procedures and conditions for indirect testing instead of direct testing will be studied to reduce the number of direct tests for conformity control under types II and III.

NOTES

7 The normal inspection level as defined in ISO 2859 and ISO 3951 has been chosen.

8 The sample size has been chosen on the assumption that for inspection by attributes, a double sampling plan will be applied. In the case of inspection by variables, an equivalent sample size has been chosen.

F.5 Acceptance criteria

F.5.1 Test specimens

For acceptance testing, all boards of a package (one item) are deemed to be of the same quality, so that the necessary test specimens may be taken or cut out of the item at the discretion of the tester, subject to

1) For lots considerably smaller than 1 000 m^2, the method of compliance control recommended in this International Standard is not economic; special agreements, depending on the importance of the application, should be made between manufacturer and purchaser.

Table F.1 — Sampling plan

Conformity control system								
Type I				**Types II and III**				
	Sample size (number of items)			**Lot size**		**Sample size (number of items)**		
Lot size	Attribute testing					Attribute testing		
m^2	First sample	Total	Testing by variables	m^2 [1]	Production for [1] (No. of days)	First sample	Total	Testing by variables
1 500	2	4	3	150 000	1	2	4	3
2 500	3	6	4	250 000	2	3	6	4
5 000	5	10	5	500 000	3	5	10	5
9 000	8	16	7	900 000	7	8	16	7
15 000	13	26	10					
28 000	20	40	15					
28 000	32	64	20					

1) The sampling shall be established either by time or by quantity, whichever gives the larger sample size.

any limitations imposed by the test method. The number of specimens from one item to get one test result (mean value) depends on the test methods given in annexes A, B, C, D and E.

F.5.2 Testing

Testing shall be carried out in accordance with the test methods given in annexes A, B, C, D and E.

F.5.3 Classification of defects

The defects for the different properties shall be classified in accordance with table F.2, unless a different classification is agreed upon for certain applications.

All properties shall be considered separately. The lot shall be rejected if any property fails to achieve the relevant acceptance criteria for that property.

F.5.4 Acceptance criteria for inspection by attributes

The compliance criteria of this clause and F.5.5 imply the following AQLs for the defect classes:

— Critical defects: The judgment of fire behaviour depends on national regulations;

— Major defects: AQL = 10;

— Minor defects: AQL = 15.

The chosen AQL does not imply that the producer has the right to supply knowingly any defective item of the product.

The number of items tested initially shall be equal to the sample size of column 1 of table F.3. If the number of defectives found in the first sample for the relevant property is equal to or less than the first acceptance number Ac (column 3 or 7 in table F.3), the lot shall be considered acceptable.

If the number of defectives found in the first sample for the relevant property is equal to or greater than the first rejection number Re (column 4 or 8 in table F.3), the lot shall be rejected.

If the number of defectives found in the first sample for the relevant property is between the first acceptance and rejection numbers, the total sample size (column 2 in table F.3) shall be inspected for the relevant property. The number of defectives found in the first and second sample shall be accumulated.

If the total number of defectives for the relevant property is equal to or less than the total acceptance number Ac (column 5 or 9 in table F.3), the lot shall be considered acceptable; if the total number of defectives for the relevant property is equal to or greater than the total rejection number Re (column 6 or 10 in table F.3), the lot shall be rejected.

Table F.2 — Classification of defects

Classification of defects	Property	Subclause reference in this International Standard
Critical defects	Fire behaviour	5.2
Major defects	Thermal resistance or thermal conductivity	5.3
	Deformation resistance	5.4
	Interlaminar strength	5.5
	Thickness (when the thermal property is defined as λ)	5.1
Minor defects	Dimensional tolerances on	
	— length	5.1
	— width	5.1
	— thickness (when thermal property is defined as R)	5.1
	— squareness	5.1
	— flatness	5.1
	Breaking load	5.6

Table F.3 — Acceptance criteria for inspection by attributes

Sample size		Major defects				Minor defects			
First sample	Total sample	First sample		Total sample		First sample		Total sample	
		Ac	Re	Ac	Re	Ac	Re	Ac	Re
1	2	3	4	5	6	7	8	9	10
2	4	0	2	1	2	0	2	1	2
3	6	0	2	1	2	0	3	3	4
5	10	0	3	3	4	1	4	4	5
8	16	1	4	4	5	2	5	6	7
13	26	2	5	6	7	3	7	8	9
20	40	3	8	8	9	5	9	12	13
32	64	5	9	12	13	7	11	18	19

F.5.5 Acceptance criteria for properties, where defects are classified as major, when inspected by variables

F.5.5.1 General

Testing by variables is only possible for properties which are measurable on a continuous scale, such as thermal resistance, thermal conductivity, etc. It is not applicable to measurements where tolerances are given, e.g. length, width, thickness, etc.

In accordance with F.5.3, the method is based on an AQL of 10 and acceptance criteria are worked out on the basis of the so-called s-method, in accordance with ISO 3951.

If, at the place of production, there is enough knowledge about the production process, so that the standard deviation, σ, of the process is known from at least one year's experience, the σ-method which needs a smaller sample size may be applied in accordance with ISO 3951 instead of the s-method. In this case, however, it is still necessary to calculate the estimate of the deviation of the s-method to check whether the established σ-value is still realistic.

F.5.5.2 Acceptance criteria

The lot shall be considered acceptable as a function of the thermal properties:

— if the quality statistic, Q_R, of the thermal resistance is equal to or higher than the acceptability constant k, or

— if the quality statistic, Q_λ, of the thermal conductivity is equal to or higher than the acceptability constant k.

For a defined sample size, the acceptability constant k is given in table F.4.

Table F.4 — Acceptability constant, k

Sample size n	Acceptability constant k
3	0,566
4	0,617
5	0,675
7	0,755
10	0,828
15	0,886
20	0,917

The quality statistics Q_R or Q_λ as appropriate shall be calculated by means of the following equations:

a) For thermal resistance R

$$Q_R = \frac{\overline{R} - R_L}{s} \qquad \ldots (F.1)$$

where

$\overline{R}$ is the mean value of R for the sample of n items;

R_L is 0,95 × the declared R-value (see 5.3) ($R_L = 0{,}95\ R$);

s is the estimate from the sample of the standard deviation of the lot, given by the equation:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(R_i - \overline{R})^2}{n-1}} \qquad \ldots (F.2)$$

in which

n is the number of items in the sample,

R_i are the measured R-values of the items of the sample.

b) For thermal conductivity λ

$$Q_\lambda = \frac{\lambda_u - \overline{\lambda}}{s} \qquad \ldots (F.3)$$

where

λ_u is the declared λ-value;

$\overline{\lambda}$ is the mean value of λ for the sample of n items;

s is the estimate from the sample of the standard deviation of the lot, given by the equation:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(\lambda_i - \overline{\lambda})^2}{n-1}} \qquad \ldots (F.4)$$

in which

n is the number of items in the sample,

λ_i are the measured λ-values of the items of the sample.

Annex G
(informative)

System of third-party certification of conformity of mineral wool boards

G.1 General

This annex describes a system of third-party certification of conformity of mineral wool boards. Certification of conformity means the declaration that the product is deemed to satisfy the requirements defined in the technical specifications. This assumption is based on the factory quality control and third-party inspection by an accredited certification body.[2)]

G.2 Description of the system

The system is based on the following elements:

a) factory quality control;

b) regular testing of factory samples by the manufacturer;

c) initial inspection of the plant and of the factory quality control by the certification body;

d) initial type testing of the product by the certification body;

e) audit testing of samples taken in the factory, on the open market, or on a building site, by the certification body;

f) surveillance, assessment and approval of factory quality control by the certification body.

G.3 Specification

The certification is based on the required properties (see clause 5) and the marking (see clause 6) of the product, in accordance with this International Standard.

G.4 Factory quality control

G.4.1 Factory quality control means the permanent internal control of production exercised by the manufacturer or his agent under the responsibility of the manufacturer.

The purpose of the control is to ensure that current production conforms with the technical specifications concerned.

G.4.2 Factory quality control comprises operational techniques and all measures necessary to maintain and regulate the quality of the product. It consists of inspection, raw materials and constituents, processes of manufacturing, and the product itself, and by taking account of the corresponding requirements given by the technical specifications.

All necessary facilities, equipment and personnel shall be available to carry out the necessary inspections and tests, as indicated above. This requirement may also be fulfilled, if by means of a contract the manufacturer or his agent involves a subcontractor having the necessary facilities, equipment and personnel.

G.4.3 The nature, extent and frequency of tests depend on the specific conditions of the plant and production line.

Normally, the testing is to be performed in accordance with the test methods given in the specifications. For certain properties, indirect test methods may also be used, if a correlation can be established between the specified property X — which is the property to be tested — and another property Y. In the indirect test, the property Y is measured instead of the property X (e.g. air permeability instead of thermal conductivity).

In this case, the sampling plan and the compliance criteria for the indirect property Y shall be specified after taking into account the correlation between properties X and Y.

The coefficients of the relationship between X and Y as well as the residual standard deviation σ_ε shall be determined by means of adequate preliminary tests and regression calculations. The test values for X and Y as well as the accompanying rules for deciding these values shall be coordinated on the basis of the calculated regression relationship. At the same time it should be ensured that the permeability remains the same for both test schedules. If σ_X is known, the number of samples n_Y for the indirect test shall be determined in accordance with the equation:

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2) Certification body: An impartial body, governmental or nongovernmental, possessing the necessary competence and reliability to operate a certification system, and in which the interests of all parties concerned with the functioning of the system are represented (see ISO Guide 2, subclause 14.3).

$$n_y \approx \left(1 + \frac{v}{v-2} \times \frac{s_\varepsilon^2}{\sigma_X^2}\right) n_x$$

where

n_y is the number of samples for the indirect test;

v is the number of pairs of values (X, Y) which it was possible to use in the calculation of the regression coefficients a and b

$$(X = a + b\,Y + \varepsilon = X_{ind} + \varepsilon);$$

s_ε is the estimated value for the residual standard deviation σ_ε of the deviation $\varepsilon = X - X_{ind}$.

The correctness of the regression relationship between the specified property and the indirect test value shall be examined at certain intervals, e.g. during the audit test carried out by the certification body. The examination shall also take place each time the production conditions change (e.g. when a new manufacturing procedure is introduced). The examination of correctness of the relationship shall be carried out separately for each place of production which operates under the same conditions.

G.4.4 For the production of mineral wool boards as specified in this International Standard, the minimum frequency of tests and inspections to be performed by the manufacturer is specified in G.4.4.1 to G.4.4.3.

G.4.4.1 All controls on raw and constituent materials and processes shall be agreed between the producer and the certification body according to the principles given below. They shall be considered as general information while the criteria for quality compliance should be by testing the finished product.

The main components for fibres and binders are checked by analysis (composition) per batch delivered, or checked randomly if the supplier certifies each batch delivered.

Furnace and fibrizing processes are to be controlled continuously.

G.4.4.2 See table G.1 for the minimum frequency of tests (calibration) and inspection for control of test equipment.

The calibrations have to be repeated if any repair or failure occurs.

G.4.4.3 See table G.2 for the minimum frequency of tests for control of the finished product for each production line.

G.4.5 The results of factory quality control are to be recorded in the manufacturer's log. The log must contain a record of the description of the product, the date of manufacture, the testing methods and limits used, and the signature of the person carrying out the inspection.

Where the products inspected do not satisfy the requirements as to quality laid down in the specifications, or if there is an indication that they do not do so, a note is to be made in the manufacturer's log as to the steps taken to deal with the situation (e.g. carrying out a new inspection and/or measures to correct the production process).

The manufacturer's log is to be made available to the certification body and must be kept for at least five years.

Table G.1

Equipment for testing of	Frequency
Air permeability	Once a year: e.g. for SLR with reference to an internal or external laboratory; e.g. for micronaire using calibrated reference cotton fibres
Mass	Every month weighing system (balance) shall be checked with reference to "calibrated weights"
Dimensions/ squareness	No special requirements
Thermal conductivity or resistance	Once a week using internal reference sample; once a year combined with the external control by comparison with an accredited laboratory
Mechanical properties	Once a year by an external body

G.4.6 At every factory unit, where mineral wool boards are manufactured, the manufacturer must appoint a person, who shall have appropriate knowledge and experience of the production of mats, to be responsible for conducting and supervising factory quality control procedures and ensuring that entries in the log are duly made.

G.4.7 If the result of the test is unsatisfactory, the manufacturer is obliged at once to take the steps necessary to rectify the shortcoming. Products which do not comply with the requirements are to be set aside and marked accordingly. When the shortcoming

has been rectified, the test in question is to be repeated without delay, provided that this is technically possible; it is necessary as evidence that the defects have been overcome.

Notification shall be made to customers, if necessary, for the purpose of avoiding any consequential damage.

G.5 Third-party type testing and surveillance

G.5.1 General

The certification body, responsible for type testing, initial inspection, and surveillance of the factory, shall have the necessary competence, impartiality, and integrity to fulfil these tasks. It shall be accredited for this task by the national authority or another body which is authorized to accredit certification bodies.

G.5.2 Type testing

Prior to beginning surveillance of the plant, each product type, which claims to be under the rule of the certification scheme, shall be tested completely in accordance with this International Standard.

In the case of products differing only in the kind of facing or their dimensions, there is no need for separate testing of properties which are not affected by the different facing or dimensions.

The samples for type testing shall normally be taken by the certification body during the initial inspection of the plant.

A sample shall normally be one package of boards but not less than five boards.

The sample shall be taken out of the inspection lot, at random, without regard to its quality, on the sampler's discretion; it shall be marked so that there is no possibility of error. The sampler shall prepare a record of the sampling procedure. The test report must comply with clause 7 of this International Standard.

G.5.3 Initial inspection

The initial inspection is for the purpose of determining whether the prerequisites, in terms of staff and equipment for continuous and orderly manufacture and for the corresponding internal control, appear to be suitable.

The inspector of the certification body shall, among other things, examine the following essential elements of the manufacturer's quality control system, and will assess their suitability:

a) staffing, in particular the terms of reference and status of the manufacturer's inspection department;

b) inspection methods and procedures in general, including complaint procedures and their documentation;

c) testing equipment;

d) quality control of raw materials and constituents, batch identification, and control;

e) product marking and production code;

f) disposal of inspection rejects;

g) procedures for product corrections;

h) internal documentation, including test records, production records, material certificates, etc.;

i) availability of the technical requirements for the product (for example, the specifications), "scheme of supervision and control", "quality manual", and other documents essential for the factory inspection;

j) attitude of top management to quality control in general, and to the proposed scheme in particular.

All relevant facts of the initial inspection, especially the quality control system operated by the manufacturer and the assessment of the acceptability of this system, shall be documented in a report.

G.5.4 Routine inspections

The principal objective of routine testing is to check whether the prerequisites for manufacturing and the agreed factory quality control system are being maintained or improved.

For this purpose, the report of the initial factory inspection as a statement of the agreed quality control system is used.

During a routine inspection, for example, the test results are to be examined to ensure that the required testing has been carried out at the appropriate frequency and that proper action has been taken in the event of any failure recorded. Other records are checked, including those on calibration and maintenance of test equipment. Marking and labelling of the products have also to be checked.

The results of the routine inspection are to be documented in a record of the inspection.

The routine inspections shall normally be performed twice a year; they shall not be announced in advance to the factory.

G.5.5 Audit testing

During the routine testing, at the discretion of the certification body, samples from the factory-inspected production shall be taken for testing in compliance with the specifications.

The minimum frequency of audit testing of the finished product by the certification body should not be less than specified in table G.3.

G.5.6 Measures in cases of noncompliance with the specifications or other omissions

In cases where noncompliance with the specifications is identified or complaints have been revealed in the manufacturing process or in the factory quality control, the certification body asks the manufacturer to rectify the defect within a reasonably short period, not exceeding one month.

In cases of serious faults or complaints after this period of time has expired, an extraordinary inspection shall be performed by the certification body.

If this inspection and the follow-up tests are not passed, the certification body should normally discontinue control of the tested product or type of product and will inform the manufacturer and the competent authority. After control has been discontinued, the products must no longer be marked in accordance with the certification scheme.

Table G.2

Measured property	Frequency[1]		Purpose
	Minimum per day[2]		
Air permeability	3[3]	At every change in the process	To predict thermal conductivity or thermal resistance
Mass per unit area	24	At every change of the nominal line mass or of the product	To assist in predicting the thermal conductivity or resistance
Thickness	24	At every change of the product or of the thickness	To check compliance with the requirements
Dimensions: length and width	24	At every change of the product or of the dimensions	To check compliance with the requirements
Density	24[3]	At every change of the product or of the thickness	To predict thermal conductivity or thermal resistance
Squareness	12	At every change of the dimensions	To check compliance with the requirements
Binder content	12	At every change of the binder content	To predict fire behaviour and mechanical properties
Thermal conductivity or thermal resistance	0,4[3]	At every change in the process	To check the compliance with the requirements and to verify the validity of λ compared with density and air permeability correlations
Breaking load	3		To check compliance with the requirements
Interlaminar strength	3		To check compliance with the requirements
Deformation resistance	3		To predict the deformation resistance

1) The sample unit is at least one board.

2) Daytime production is considered as 24 h.

3) If the frequency of testing the thermal conductivity is significantly higher, then the frequency of testing the air permeability and density may be reduced.

Table G.3

Measured property	Minimum frequency for each type of product
Dimensions: length width thickness squareness	Once per year at two different thicknesses
Thermal transmission properties (R or λ)	Once per year at two different thicknesses
Deformation resistance	Once per year at two different thicknesses
Interlaminar strength	Once per year at two different thicknesses
Breaking load	Once per year at two different thicknesses
Fire behaviour	According to national regulations

G.5.7 Mark of conformity

Each product which is under the regime of a certification scheme shall be marked with a mark of conformity on the label in accordance with clause 6 of this International Standard. As soon as and provided that the manufacturing unit has passed the initial inspection and the product has passed the initial type testing, the certification body will authorize the use of the mark of conformity.

The mark of conformity to show compliance with this International Standard shall refer to ISO 8145 and shall indicate the certification body.

As soon as and provided that the certification body has discontinued its surveillance, the manufacturer is no longer allowed to use the conformity mark.

Annex H
(informative)

Bibliography

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