INTERNATIONAL STANDARD

ISO 8144-1

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Thermal insulation — Mineral wool mats for ventilated roof spaces —

Part 1:
Specification for applications with restricted ventilation

Isolation thermique — Feutres en laine minérale pour sous-toitures ventilées —

Partie 1: Spécifications pour application dans des conditions de ventilation restreinte

Reference number
ISO 8144-1:1995(E)

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 8144-1 was prepared by Technical Committee ISO/TC 163, *Thermal insulation*, Subcommittee SC 3, *Insulation products for building applications*.

ISO 8144 consists of the following parts, under the general title *Thermal insulation — Mineral wool mats for ventilated roof spaces*:

— *Part 1: Specification for applications with restricted ventilation*

— *Part 2: Specification for horizontal applications with unrestricted ventilation*

Annexes A, B and C form an integral part of this part of ISO 8144. Annexes D, E and F are for information only.

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Thermal insulation — Mineral wool mats for ventilated roof spaces —

Part 1:
Specification for applications with restricted ventilation

1 Scope

This part of ISO 8144 specifies the properties and acceptable tolerances for bonded man-made mineral wool thermal insulating mats (batts and rolls). The mats specified in this part of ISO 8144 are for use within ventilated roof spaces of buildings where the essential ventilation of the roof space may be restricted if the thickness recovery of the insulation is excessive. [See annex E and ISO/TR 9774:1990 (figure 1, sketches 1 and 5) for typical locations.] They may be supplied flat, folded or in the form of a roll.

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. Essentially, mats do not change their properties and are dimensionally stable for the temperature and humidity conditions within a ventilated roof.

This part of ISO 8144 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 10456.

Mats may be supplied with a factory-applied facing, but facings are not covered by this part of ISO 8144.

In general, mats are not designed to support any applied load. For this reason, only the mechanical properties required for adequate handling during application are specified.

The sampling and conformity control procedures described in annex D, and the certification procedure described in annex F, are recommendations only.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8144. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8144 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 9774:1990, *Thermal-insulation materials — Application categories and basic requirements — Guidelines for the harmonization of International Standards and other specifications.*

ISO 10456:—[1], *Thermal insulation — Building materials and products — Determination of declared and design thermal values.*

3 Definitions

For the purposes of this part of ISO 8144, the following definitions apply.

3.1 mineral wool: Vitreous fibres having a woolly consistency made from rock, slag or glass.

3.2 mat: Flexible fibrous insulation supplied in the form of rolls or batts, which may be faced but not enclosed.

3.3 batt: Portion of a mat in the form of a rectangular piece, generally between 1 m and 3 m in length and usually supplied flat or folded.

3.4 roll: Mat supplied in the form of spirally wound cylindrical packages.

4 Sampling and conformity control

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

NOTE 1 Annexes D and F, which are not normative parts of this part of ISO 8144, 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 being prepared and will replace the common clauses of annexes.

1) To be published.

5 Required properties

5.1 Dimensions

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

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

5.2 Fire behaviour

These insulation materials, including any facings, shall meet the fire regulations and codes that apply in the locality in which they are applied.

Table 1 — Dimensional tolerances

Dimension	Permissible deviations of measured values from nominal dimensions	Test method
Length, l	− 2 %, + excess permitted on average of measured values for each single specimen	Clause A.1
Width, b	± 2 % or ± 10 mm, whichever is less, on average of measured values for each single specimen	Clause A.1
Thickness, d	− 5 %, + 20 %, (the plus tolerance is limited to a maximum of + 15 mm) on average of all specimens tested For any single specimen, the measured thickness at each individual measuring point shall not deviate by more than 10 mm from the mean of measurement on that specimen	Clause A.2
Squareness of batts (rolls need not be tested)	For each 100 mm along the shortest face dimension, the maximum deviation shall not be more than 1 mm	Clause A.3

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

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

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

NOTES

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

3 Because of the differences in manufacturing processes, two manufacturers may have the same thermal resistance but at slightly different thicknesses and/or densities.

5.4 Handling properties

The product shall have sufficient strength to be handled, transported and installed. When tested in accordance with the test method in annex B, the specimen shall support twice the mass of the mat or twice the mass of a specimen 10 m in length, whichever is less. It is normally not necessary to test faced products.

5.5 General properties

5.5.1 There are no test procedures specified for the following properties: however, for the requirements in 5.5.2 and 5.5.4, visual inspection and simple odour are respectively recommended.

For the properties of 5.5.3 and 5.5.5, the manufacturer shall be consulted and shall provide technical information.

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

5.5.3 The insulation shall not sustain the growth of fungus.

5.5.4 The insulation shall be free from objectionable odours.

5.5.5 The insulation shall not accelerate the corrosion of metallic surfaces with which it may come into contact in normal use.

6 Marking

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

a) 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 the 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 part of ISO 8144.

7 Test report

The test report shall be prepared by the laboratory that carried out the tests and shall include the following information:

a) manufacturer's name and product designation;

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

c) nominal dimensions;

d) production code;

e) information about sampling;

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

g) report of all test results, including maximum and minimum values, and deviation of individual thickness measurements from mean specimen thickness;

h) comparison of test results and assessment with the manufacturer's claim and the requirements of this part of ISO 8144;

i) statement of conformity with this part of ISO 8144;

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

Annex A
(normative)

Determination of dimensions of mats (batts or rolls)

A.1 Determination of length and width

A.1.1 Measuring device

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

A.1.2 Specimens

All mats (batts or rolls) contained in one package, but not more than five batts selected by random sampling, shall be tested.

After opening the package, the mats shall be laid carefully on a flat surface (the rolls unrolled) and the dimensions measured.

A.1.3 Procedure

Place the steel tape (A.1.1) across the surface of the insulation material 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 of length shall be read and rounded to the nearest 5 mm, and of width to the nearest 2 mm.

The length and width recorded shall be the mean of these measurements for each specimen.

Note the results in the test report.

A.1.4 Test report

The test report shall indicate the mean of the measurements of length and width for each specimen.

A.2 Determination of thickness

A.2.1 Principle

Measurement of the distance between a hard surface compatible with the specimen and on which the test specimen rests, and a pressure plate resting freely on the surface of that specimen.

A.2.2 Measuring device

The measuring device consists of a pressure plate and a pin.

The plate may be made from clear or transparent plastic or another suitable material. It shall be 200 mm square, fitted with a suitable thumb grip. The total mass of the plate and the grip shall be within the range 198 g to 210 g, so that it exerts a pressure on the specimen of 50 Pa $\pm$ 1,5 Pa (see figure A.2).

The pin is made from steel rod 3 mm in diameter, and is sufficiently long to penetrate the full thickness of the specimen (see figure A.3), with 20 mm of one end sharpened to a point.

NOTE 4 Other measuring devices such as a dial gauge may be used, provided that the pressure plate exerts a load of 50 Pa $\pm$ 1,5 Pa over an area 200 mm square.

A.2.3 Specimens

All mats (batts or rolls) contained in one package shall be tested.

Immediately after opening the package, batts shall be placed on a hard, flat, horizontal reference surface. If faced, the facing shall be placed downwards against this surface.

Rolls shall be completely unrolled and cut into pieces 1 m to 1,5 m long, discarding the first and last 0,5 m length of the roll. These pieces shall then be placed

on a horizontal hard reference surface with the facing, if any, downwards.

Before thickness measurements are taken, the products which have been compressed in the package, and which in the package have a thickness less than 90 % of the nominal thickness, shall be conditioned according to the following procedure:

a) hold the piece vertically in both hands by the long edge, so that the other long edge is approximately 450 mm above the floor;

b) drop the piece once so that it strikes the floor;

c) repeat operations a) and b) on the opposite edge for all mats in the package or all the pieces cut from a roll;

d) before taking any measurements, wait at least 5 min for the pieces to reach a state of equilibrium.

A.2.4 Procedure

At each point marked as shown in figure A.4, place the pressure plate on the specimen, lowering the plate slowly until it comes in contact with the surface, allowing it to rest freely under its own weight.

Force the pin with a rotating motion vertically downward through the specimen to the surface below.

Grasp the pin firmly at the thumb grip, and remove both the pin and the plate. Measure the distance from the point of the pin to the plate, to the nearest 1 mm. This distance is the thickness of the specimen at that point.

The thickness of the specimen shall be the average of the measurements made at all points on the specimen (see figure A.4).

Calculate the average of all the specimen thicknesses and report this as the average sample thickness.

Record the deviation of each thickness measurement from the mean of thickness measurements for each specimen.

Note the results in the test report.

A.2.5 Test report

The test report shall include the following information:

a) the average thickness of each specimen;

b) the average thickness of all the specimens as the average sample thickness;

c) the deviation of each thickness measurement from the mean of the thickness measurements for each specimen.

A.3 Determination of squareness

A.3.1 Principle

Determination of the deviation from the squareness of the corners for a batt with a length less than 3 m.

A.3.2 Measuring devices

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

A.3.3 Specimens

All batts contained in one package, but not more than five, randomly selected, shall be tested.

A.3.4 Procedure

Lay the specimen material on a flat surface and measure the deviation from squareness of the corners as follows.

Position the carpenter's steel square along one side 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, at the point of greatest deviation between the edge of the specimen and the edge of the square. Record the distance in millimetres.

Calculate the deviation from squareness for the corners, expressed in millimetres per 100 mm, for each batt, and note the result in a test report.

A.3.5 Test report

The test report shall indicate the maximum deviation from squareness for batts, expressed in millimetres per 100 mm.

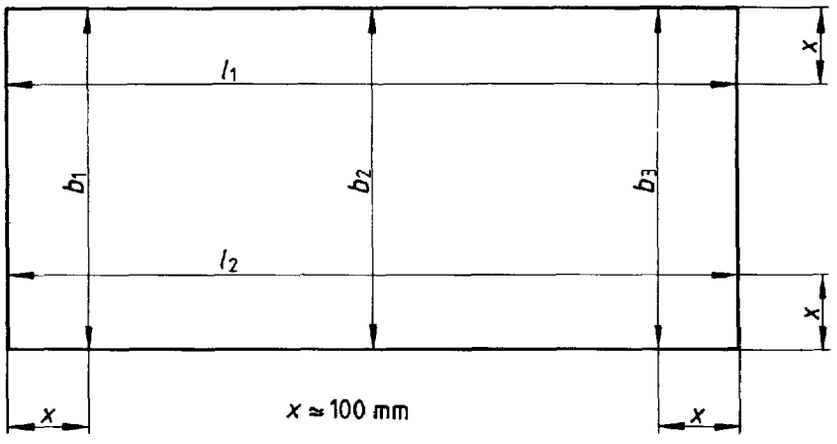


Figure A.1 — Location of measurements for length and width

Dimensions in millimetres

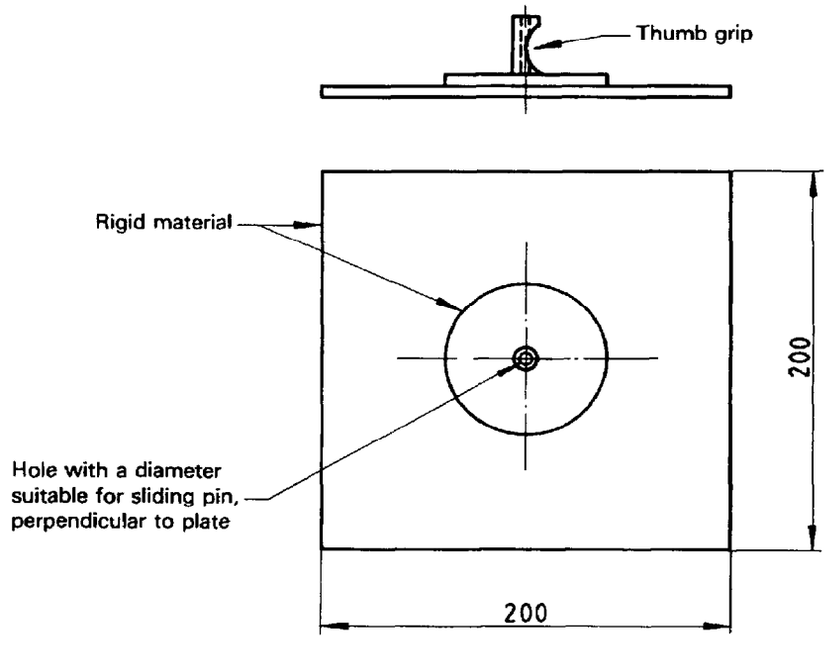


Figure A.2 — Pressure plate

Dimensions in millimetres

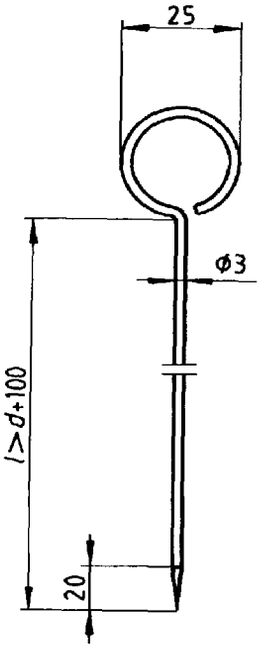


Figure A.3 — Pin

Dimensions in millimetres

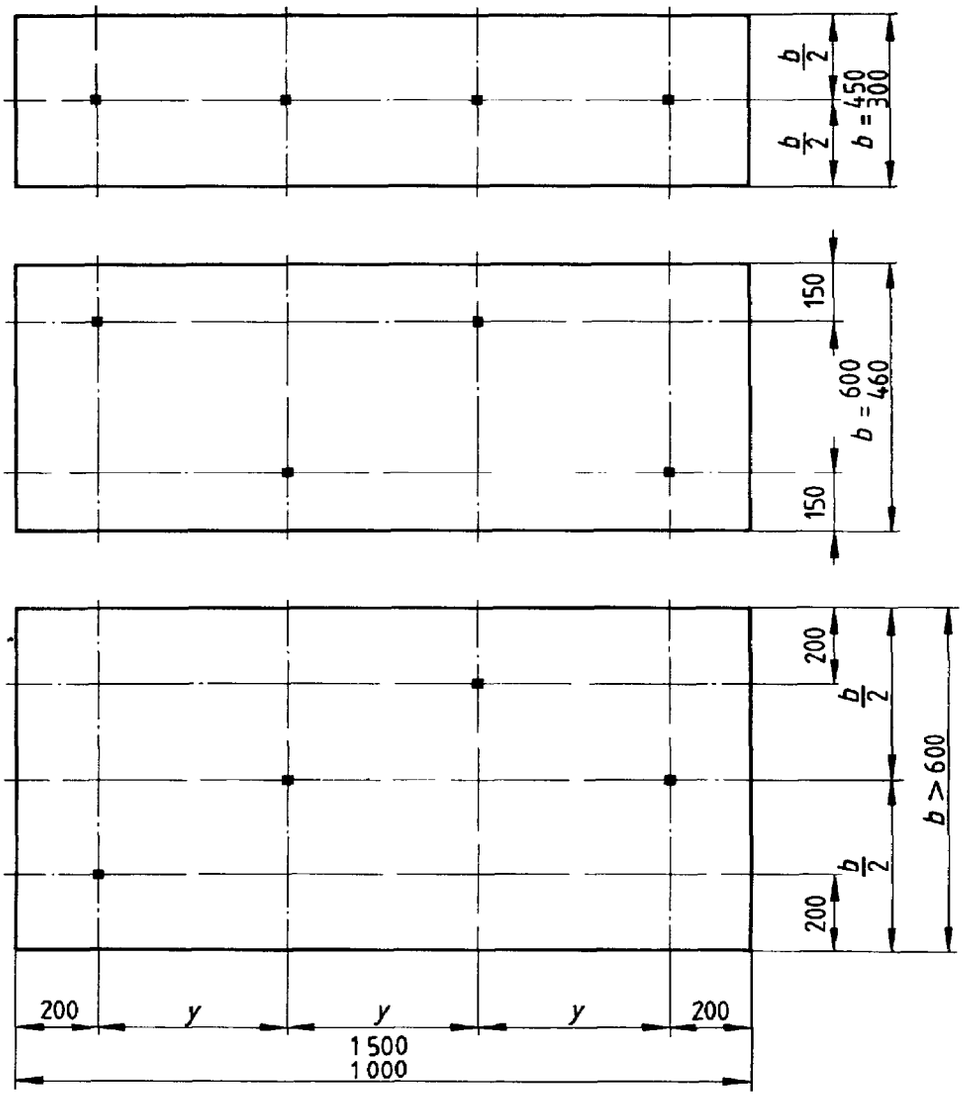


Figure A.4 — Locations for thickness measurements

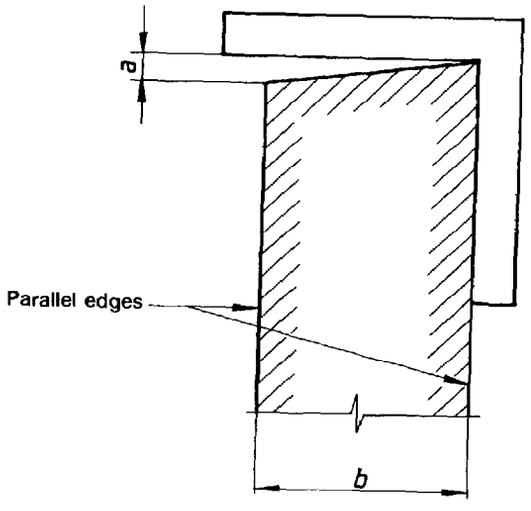


Figure A.5 — Measurement of squareness

Annex B
(normative)

Determination of handling properties of mats (batts or rolls)

B.1 Equipment

The measuring equipment consists of

— a tensile test machine or other suitable loading device, for instance a bucket loaded with sand;

— two sets or grip clamps for holding the specimens, so that the full width of the specimen is held with ropes or equivalent for central loading by a test machine or bucket (see figure B.1).

In the case where a bucket is used as the loading device, it consists of

— a lightweight bucket, suitable for holding about 10 kg of sand;

— a supply of dry sand (about 10 kg for most tests).

B.2 Specimens

One test specimen shall be taken from each sample package.

Each specimen shall be the full width of the original mat. The length of the specimen shall be at least twice the width. When the length is less, the whole mat shall be taken. To test mats with a width more than 500 mm, a 500 mm wide test specimen may be cut out of the mat.

B.3 Procedure

Attach the top set of clamps to one end of the specimen and the lower set of clamps to the opposite end of the specimen. Suspend the assembly vertically in a test machine or attach a bucket to the lower clamp so that it clears the floor.

Load the specimen carefully by machine or by adding sand or another loading material to the bucket so that the total load, including the mass of the specimen, lower clamp and bucket and sand if used, is twice the mass of the original mat or twice the mass of a 10 m length of mat, whichever is less. For specimens which have a narrower width, the load shall be adjusted accordingly.

Maintain the loaded assembly for not less than 1 min.

NOTE 5 Should failure occur at the clamp, discard the specimen and conduct a new test. If failure occurs frequently at the clamp, choose another form of clamp or specimen (e.g. dumb-bell or dogbone shape).

Record the number of specimens tested and the number which failed to support the load. Note the results in a test report.

B.4 Test report

The test report shall indicate the number of specimens tested and the number of specimens which failed to support the load.

Dimensions in millimetres

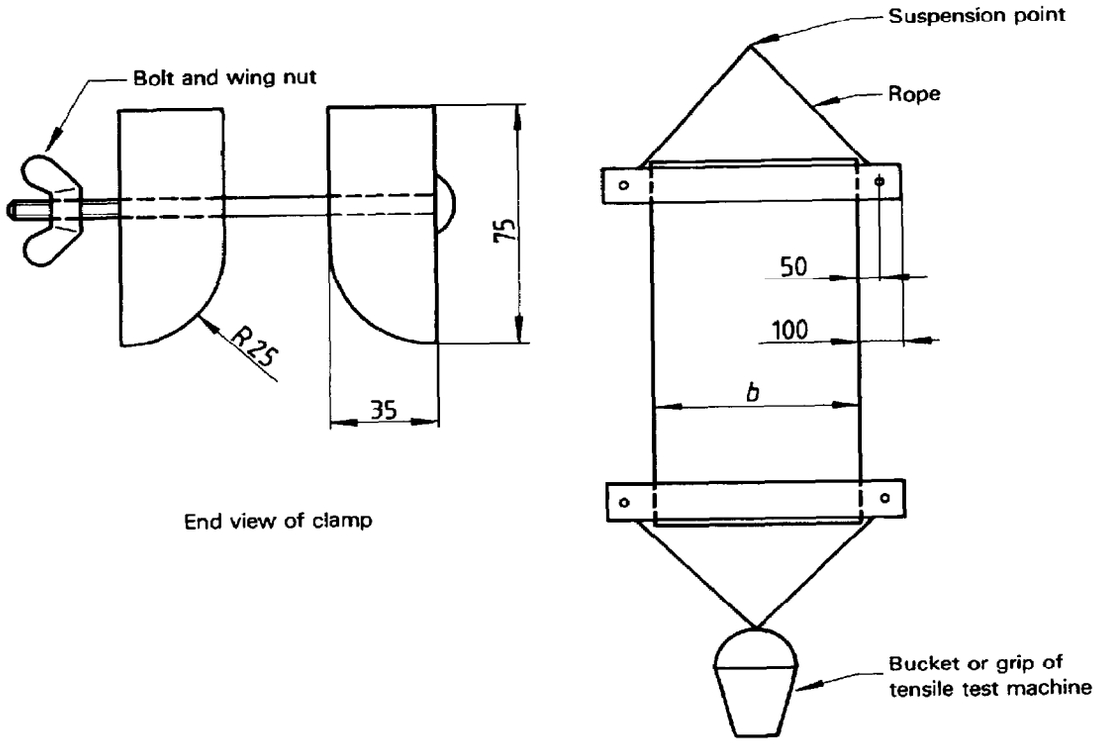


Figure B.1 — Suspended assembly

Annex C
(normative)

Determination of thermal transmission properties

C.1 General

Thermal transmission properties shall be determined according to ISO 8301 (heat flow meter) or ISO 8302 (guarded hot plate). In case of dispute, the guarded hot-plate method shall be used.

The heat flow meter and guarded hot plate are used to measure the areal density of heat flow rate 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 the conductivity λ of the test specimen at thickness d, the thickness tested is to be inserted.

C.2 Specimens

From each sample, two specimens shall be cut out of the mat or test piece on which thickness measurements have been made and which, in the case of compressed material, have been conditioned (see A.2.3). If, during specimen preparation (e.g. cutting of the specimen), the material has been compressed, this conditioning shall be repeated before thermal measurements are 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 a guarded hot-plate or heat flow meter, specimens with the thickness available may be used, provided:

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

b) that 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 by more than the precision of the test procedure.

C.3 Procedure

The following procedure shall be used:

a) measure the thickness of the specimens in accordance with A.2.4;

b) measure the thermal resistance, R, or the thermal conductivity, λ, according to ISO 8301 or ISO 8302, use the nominal thickness of the specimen, or the measured thickness, whichever is less;

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 the λ-value from measured values of R and d;

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

f) calculate the average R-value using the average λ-value and either the nominal thickness or measured thickness of all the specimens, whichever is less.

C.4 Test report

The test report shall include the following information:

a) nominal or test thickness d of specimens;

b) λ- and R-values of each specimen;

c) average λ- and R-values;

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

Annex D
(informative)

Sampling and conformity control

D.1 Scope

This annex recommends certain rules for the conformity control of mineral wool mats, 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 mats should be accepted as conforming to the requirements of this part of ISO 8144. It may be applied on agreement between the manufacturer and purchaser, in the absence of regulations in the locality where the insulation is used.

D.2 References

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*

ISO 2859-2:1985, *Sampling procedures for inspection by attributes — Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*

ISO 2859-3:1991, *Sampling procedures for inspection by attributes — Part 3: Skip-lot sampling procedures*

ISO 3951:1989, *Sampling procedures and charts for inspection by variables for percent nonconforming*

ISO/IEC Guide 22:1982, *Information on manufacturer's declaration of conformity with standards or other technical specifications.*

D.3 Definitions

D.3.1 consignment: Quantity of packages, batts or rolls of the same category delivered at one time. The consignment may consist of one or more inspection lot(s) or parts of an inspection lot.

D.3.2 inspection lot: Definite quantity of packages (batts or rolls) 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.

D.3.3 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 constitutes the sample size.

D.3.4 test specimen: Single item or part of an item used for a test.

D.3.5 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.

D.3.6 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.

D.3.7 conformity control: Performance of control methods to prove whether a product can be accepted as conforming to specified requirements.

D.3.8 acceptance testing: Tests to be carried out to prove whether a product can be accepted as conforming to specified requirements.

D.3.9 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 made on the lot and not on the ongoing production as a whole.

D.3.10 manufacturer's declaration of conformity: Action by which a manufacturer declares under his own responsability, by means of a "declaration of conformity", that the product is in conformity with the specification, without being under the procedures of a third-party certification system.

D.3.11 certification of conformity: Delivery of a document issued by a third party, independent of the manufacturer, stating that the product is in conformity with the specification.

D.3.12 verification: Validation by a third party, independent of the manufacturer, of the manufacturer's declaration of conformity.

D.4 Conformity control systems

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

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 the manufacturer and purchaser that lot testing is only to be performed in case of dispute.

Type II

Certification or verification by a third party, independent of the manufacturer, that the production is under the 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, out of production, on samples to verify the results of the manufacturer's quality control testing.

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

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

D.5 Inspection lot and sampling plan

D.5.1 General

D.5.1.1 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 in the same plant, on the same production line and in a limited time period.

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

An inspection lot may consist of one or more identical homogeneous consignments, if they were produced under identical 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 %.

D.5.1.2 Sampling

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

The items shall be taken from 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.

D.5.2 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 D.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.

2) For lots considerably smaller than 1 000 m^2, the method of compliance control recommended in this part of ISO 8144 is not economic; special agreements, depending on the importance of the application, should be made between the manufacturer and purchaser.

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, for example in case of doubt or by agreement between the manufacturer and purchaser, the size of the lot shall be that given in table D.1 for types II and III.

For subsequent revisions of this part of ISO 8144, 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

6 The normal inspection level has been chosen according to ISO 2859 and ISO 3951.

7 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.

D.6 Acceptance criteria

D.6.1 Test specimens

For acceptance testing, all boards of a package or one roll (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 any limitations imposed by the test method. The number of specimens from one item to obtain one test result (average value) depends on the test methods given in annexes A, B and C.

D.6.2 Testing

Testing shall be carried out according to the test methods given in annexes A, B and C.

D.6.3 Classification of defects

The defects for the different properties shall be classified in accordance with table D.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.

D.6.4 Acceptance criteria for inspection by attributes

The compliance criteria of this subclause and D.6.5 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: NQA = 15

Table D.1 — Sampling plan

Conformity control system								
Type I				Types II and III				
Lot size	Sample size (number of items)			Lot size		Sample size (number of items)		
	Attribute testing		Testing by variables			Attribute testing		Testing by variables
m^2	First sample	Total		m^2 1)	Production for 1) (No. of days)	First sample	Total	
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.

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 initally shall be equal to the sample size of column 1 of table D.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 D.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 D.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 D.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 D.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 D.3), the lot shall be rejected.

Table D.2 — Classification of defects

Classification of defects	Property	Clause reference in this part of ISO 8144
Critical defects	Fire behaviour	5.2
Major defects	Thermal resistance or thermal conductivity	5.3
	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
	Handling properties	5.4

Table D.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

D.6.5 Acceptance criteria for properties, where defects are classified as major, when inspected by variables

D.6.5.1 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 D.6.3, 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 in 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 value σ is still realistic.

D.6.5.2 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 D.4.

Table D.4 — Acceptability constant

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

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

where

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

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

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

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

in which

n is the number of items in the sample,

R_i is the measured R-value of the items of the sample.

b) For thermal conductivity, λ

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

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

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

in which

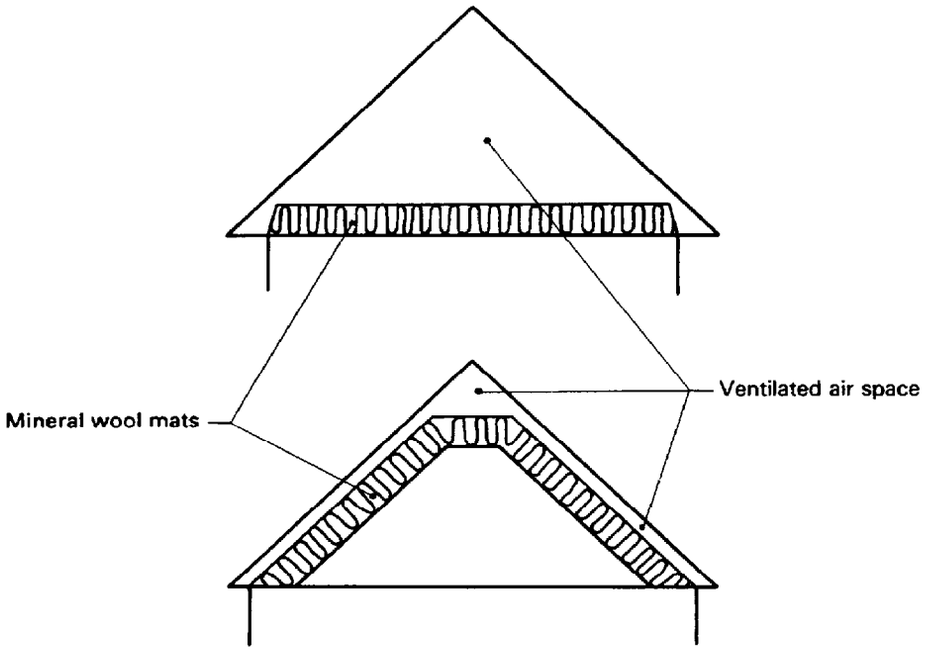
n is the number of items in the sample,

λ_i is the measured λ-value of the items of the sample.

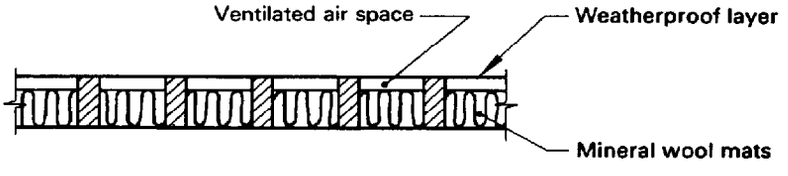
Annex E
(informative)

Typical locations for mineral wool mats

This annex shows only an indication of the locations of the mineral wool mats in ventilated roof spaces (see figure E.1). It is not intended to provide application details, as these should be obtained from other documents such as national or international building codes.



a) for pitched roofs



b) for horizontal roofs

Figure E.1 — Typical locations for insulation in ventilated roof spaces

Annex F
(informative)

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

F.1 Scope

This annex describes a system of third-party certification of conformity of mineral wool mats. 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.[3)]

F.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.

F.3 Specification

The certification is based on the required properties (see clause 5) and the marking (see clause 6) of the product, according to this part of ISO 8144.

F.4 Factory quality control

F.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 the current production conforms with the technical specifications concerned.

F.4.2 Factory quality control comprises operational techniques and all measures necessary to maintain and regulate the quality of the product. It consists of inspections and the utilization of their results with regard to equipment, raw materials and constituents, processes of manufacturing, and the product itself, and by taking into account 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.

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

Normally, testing is to be performed according to the test methods given in the specification. For certain properties, indirect 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 coompliance 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

3) Certification body: Body that conducts certification of conformity (see 14.3 of ISO/IEC Guide 2:1991, *General terms and their definitions concerning standardization and related activities*).

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

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

where

n_Y is the number of samples for the indirect test;

n_X is the number of samples tested;

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

$$(X = a + bY + \varepsilon = X_{ind} + \varepsilon);$$

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, for example 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.

F.4.4 For the production of mineral wool mats, as specified in this part of ISO 8144, the minimum frequency of tests and inspections to be performed by the manufacturer is shown in F.4.4.1 to F.4.4.3.

F.4.4.1 Minimum frequency of tests and inspections for the control of raw and constituent materials and production processes.

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 result from 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.

F.4.4.2 Minimum frequency of tests (calibration) and inspection for control of test equipment.

See table F.1.

Table F.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 the 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

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

F.4.4.3 Minimum frequency of tests for control of the finished product for each production line

See table F.2.

F.4.5 Manufacturer's log

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, of 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. car-

rying 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.

F.4.6 Persons responsible for factory quality control

At every factory unit where mineral wool mats 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.

F.4.7 Measure in the event of non-compliance with the requirements

If the result of the test is unsatisfactory, the manufacturer is obliged to take the steps necessary to rectify the shortcoming at once. 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.

Table F.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 the compliance with the requirements
Dimensions: length and width	24	At every change of the product or of the dimensions	To check the 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 (for batts)	12	At every change of the dimensions	To check the compliance with the requirements
Binder content	3	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
Tensile strength	3		To check the compliance with the requirements and predict handling properties

1) The sample unit is at least one mat, one package of batts, or one roll.

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.

F.5 Third-party type testing and surveillance

F.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.

F.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 part of ISO 8144.

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 batts but not less than 5 batts or at least one roll.

The sample shall be taken out of the inspection lot, at random, without regard to its quality, at 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.

F.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 (e.g. 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.

F.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.

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

Table F.3

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

F.5.6 Measures in cases of non-compliance with the specifications or other omissions

In cases where non-compliance 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.

F.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. 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 part of ISO 8144 shall refer to it 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.

ICS 91.120.10

Descriptors: thermal insulation, buildings, roofs, thermal insulating materials, mineral fibres, insulating mats, specifications, marking.

Price based on 25 pages